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HERBERTIA

International Journal of the American Plant Life Society, devoted to the increase and diffusion of knowledge on bulbous plants and petaloid monocot families, especially the Amaryllidaceae.

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IN THIS ISSUE...

We inaugurate the publication of two issues per year. Several new species of bulbous plants are described from locations around the world. Cultural notes on Tuberose are provided by horticultural researchers and several biographical and cultural items have been prepared by our southern California correspondent. Dr. Howard has again provided a vignette of his recent travels as well as a summary of developments in Crinum. An active New Zealand bulb grower provides some interesting information on propagation by leaf cuttings.

R. Mitchel Beauchamp, Editor

Cover: *Calochortus raichei*, from a color slide by Roger Raiche

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Volume 43, Number 1, 1987

TABLE OF CONTENTS

Calochortus raichei , A New Species from California	
Stan Farwig & Victor Girard	2
Hippeastrum wilsoniae , A New Species from Bolivia	
L.J. Doran & Fred W. Meyer	10
VALE—S. Stillman Berry, 1887–1984	
William T. Drysdale	12
A New <i>Crinum</i> from New Guinea	
L.S. Hannibal	14
Notes on Agavaceae—A New Species of Manfreda	
Pierfelice Ravenna	17
Gordon McNeil—An Autobiography	20
Bulb Production in New Zealand	
Terry Hatch	22
Hymenocallis × ‘Daphne’	
William T. Drysdale	24
<i>Hippeastrum</i> Hybrids	
Prakash Narain	25
Neo-centric Activity in Hemerocallis Linn.	
Prakash Narain	28
Growth and Flowering Responses of Polianthes tuberosa L. to Storage,	
Temperature and Duration of Treatments	
Amitabha Mukhopadhyay & M.K. Sadu	30
Importance of Nitrogen Nutrition for Polianthes tuberosa L. in India	
Amitabha Mukhopadhyay	33
Glyphosperma , A Synonym of Asphodelus	
Pierfelice Ravenna	39
<i>Haemanthus</i> / <i>Scadoxus</i>	
William T. Drysdale	42
Alien Bulbs in Western Australia	
L.J. Larsson	48
Australian Amaryllid Report	
Warren J. Glover	50
Crinum asiaticum Cultivation in Northeast Georgia	
Jeffrey Matthew Humphreys	52
Sleuthing Some Mythical Hymenocallis of Mexico	
Thad M. Howard	55
Crinum Notes—1987	
Thad M. Howard	61

CALOCHORTUS RAICHEI, A NEW SPECIES FROM CALIFORNIA

STAN FARWIG AND VICTOR GIRARD
CONCORD, CALIFORNIA

Calochortus raichei Farwig et Girard, species nova (Liliaceae).

BULBUS ovoideus tunicis crassis membranaceis. Caulis crassus, erectus, 10-100cm altus, glaucus et farinosus, plerumque simplex aut in locis favorabilibus ramosus. Folia omne glauca et farinosa; folium basile usque ad 40cm longum, 1-2cm latum, lineare, caniculatum, attenuatum; folia caulina 1-4, similia folii basilis, secus caulem sursum redacta 20-10cm. Inflorescentia (1)- 2 floribus, bracteis binatis et oppositis, anguste lanceolatis et attenuatis, usque ad 7.5cm, interdum sub anthesi tortis. Flores globobovoides, cernui, pedicellis crassis; tepala exteriora griseo-malvacea et subviridia, usque ad 2.5cm longa, late lanceolata, acuminata, glabra et sine glandibus; tepala interiora luteola, usque ad 4.5cm longa, obovata, acuminata vel acuta, in unguem decrescens, ad apicem ciliata, superficie ab glande ad apicem modice pubescenti; glans trans tepalum usque ad margines extensa, insuper fasciata pilis longis tenuibusque versus tepali basim directis. Filamenta ad basim dilatata, (7-) 9 (-12)mm longa. Antherae oblongae, obtusae, circa 6mm longae. Ovarium fusiforme, porcatum, (8-) 12 (-15)mm longum. Stylus 2-3mm longus, stigmate persistente trifido. Capsula oblonga, acuta, porcata, cernua, usque ad 35mm longa. Semen irregulare sed plerumque oblongum, atropurpureum et aliquantum lucens, testa dura, striata et reticulata.

Bulb ovoid, encased in thick membranaceous tunics. Stem stout, erect, 10-100cm tall, glaucous and farinose, usually unbranched, sometimes with incipient branches or aborted buds at nodes, or branching in favorable locations. Leaves glaucous and farinose, the basal to 40cm long, 1-2cm wide, linear, channeled, attenuate; cauline leaves 1 to 4, similar to basal leaf, reduced upwardly, 20 to 10 cm. Inflorescence (1)- 2 flowered, bracts paired and opposite, narrowly lanceolate and attenuate, to 7.5cm, sometimes twisted at flowering. Flowers, globose-obovoid, nodding on stout pedicels; outer tepals grayish mauve and pale green, to 2.5cm long, broadly lanceolate, acuminate, glabrous and without glands; inner tepals pale yellow, to 4.5cm long, obovate, acuminate to acute, tapering to a claw, ciliate to the apex, inner face moderately pubescent from the gland to the apex, the gland extending across the tepal to near the margins, banded above with long thin hairs directed toward the base of the tepal. Filaments dilated basally, (7-) 9 (-12)mm long; anthers oblong, obtuse, ca. 6mm long. Ovary fusiform, ridged, (8-) 12 (-15)mm long, style 2 to 3mm long with a persistent trifid stigma. Capsule oblong, acute, ridged, nodding, to 35mm long. Seed irregular but generally oblong, dark purple and somewhat iridescent with a hard, striate and reticulate testa. Flowering time: late May to August (Figure 1).

TYPE: California, Sonoma County, The Cedars, Headwaters of Big Austin Creek, elevation 250m, June 7, 1986, R. Raiche 602141, JEPS, holotype; CAS, GH, K, MO, RSA, isotypes.



Figure 2. *Calochortus raichei* *in situ* at Red Slide Creek, Sonoma County. Photo by R. Raiche.



Figure 1. *Calochortus raichei* at the type locality. Photo by R. Raiche.

The species is known from the headwaters and upper drainages of Big Austin and East Austin Creeks in Sonoma County, on serpentine soil, on exposed hillsides and in light to moderately shaded woodlands (Figure 2).

Calochortus raichei belongs in Section I. *Calochortus*, Subsection 1. *Pulchelli* (Owenby, 1940). The other species in this subsection are *C. amoenus* (Figure 3), *C. albus* (Figure 4), *C. pulchellus* and *C. amabilis*.

When Roger Raiche first brought this taxon to our attention, the tendency was to regard it as a distinctive local form of the Mount Diablo endemic, *Calochortus pulchellus* (Figure 5). Our initial error in this determination is not unique. It was collected at least once before, in 1947, from this locale (F. W. Hoffman 515, UC) and labeled "*Calochortus pulchellus*". Possibly the same reasoning was employed: it is clearly not *Calochortus amabilis* (Figure 6), which occurs in the vicinity, and so there remained only the other yellow-flowered member of the subsection, *C. pulchellus*, to be considered. That this latter species had previously been known only as a highly narrow endemic whose habitat is many miles away was troubling, but in the absence of material for comparison, it appeared that the plant from Sonoma County would be best assigned to the established species.

A closer examination later convinced us that *C. raichei* actually possesses more traits to distinguish it from *C. pulchellus* than does *C. amabilis*, a species segregated from *C. pulchellus* by Purdy in 1901 and generally upheld since. Furthermore, a number of these traits suggest an affinity to *Calochortus albus* at least as close as to *C. pulchellus* (Table 1).

Certain of the traits compared are commented upon for the first time and consequently have not previously been used for diagnosis; others have not been employed in quite so close a comparison. Some may best serve in an examination of living material since they tend to become obscured in the moribund state represented by herbarium specimens. All were chosen for their relevance to *Calochortus raichei*, to establish its validity and aid in determining its position within the subsection. This latter undertaking is complicated because the capsule of *Calochortus raichei*, in its lack of winged appendages, is distinctive in the subsection, although some tendency to a reduction of such appendages is found in certain species in other subsections, which may be described as "narrowly winged." Thus the capsule of *C. raichei* deepens a perception gained from the publication of the last new species of *Calochortus* from California, *Calochortus tiburonensis*. Clearly Section I. *CALOCHORTUS*, as defined by Marion Owenby, is in need of revision.

The morphology of the capsule is fundamental to Owenby's conception of the genus. His Section I. *CALOCHORTUS* is characterized as "Fruits orbicular to oblong, 3-winged..." When he published *Calochortus tiburonensis*, Albert Hill (1973) commented that certain of its features associate it with the members of Section I, while others are shared by the species of Section III. Among the latter is a linear, angled (non-winged) capsule. A subsequent cytological study (McClaren, 1979) would seem to place *C. tiburonensis* in Section I, its haploid chromosome number, $n = 10$, corresponding to the base number for the section.

Thus the capsule of *Calochortus tiburonensis* and, to a lesser degree, that of *Calochortus raichei* represent disparate elements in the section, and it is no longer delimited by Owenby's characterization. The simplest solution would be to create a new subsection for *Calochortus tiburonensis*, and insert some qualifications into Owenby's description of Section I: "Fruits orbicular to oblong to linear, 3-winged to angled..." Since this procedure broadens the concept of the section considerably by incorporating features upon which Owenby's next division is based (and fails to treat other anomalous features of *C. tiburonensis* which are not accommodated within the section as it is constituted), such a solution may be considered of questionable value. A reconsideration of the entire genus may be in order. Such a task obviously requires the skills and discernment of a taxonomist and, having considered the subject, it is wisest for amateurs to tactfully withdraw.

Mr. Raiche's extensive study of capsules of *Calochortus pulchellus* and *C. raichei* contains observations which were not included in the table because similar data are not available for the other species, but which should be noted. Although some overlapping occurs, in general the capsules of *C. raichei* are smaller and a consistent difference in the ratio of length to width is maintained. The proportion for *C. raichei* is ca. 3:1 and that for *C. pulchellus* is ca. 3:2.

When *Calochortus raichei* is seen in habitat, it is strikingly different in appearance from the other four species in the association. This is due to the glaucous coloration, and to a starkness imparted by its generally unbranched habit, fewer flowers and narrower leaves combined with its frequently greater stature and long internodes. The powdery exudate on the stem and leaves of *C. raichei* is otherwise unknown in the genus.

Calochortus raichei shows an exclusive preference for serpentine soils. This preference may explain why *Calochortus amabilis*, in close proximity at some locales, is not fully sympatric. It may also explain why the new species has proven far more intractable to cultivation than the other four members of the subsection.

No forms intermediate to the two species have been noted to date. While a cytological examination of *Calochortus raichei* is required, this absence of hybridization may also be accounted for by the difference in flowering period, the flowers of *C. raichei* commencing to open at the end of May, a time when *Calochortus amabilis* has practically ceased flowering in this area. *C. raichei* has been seen flowering in early August, which is a far more extended flowering period than other *Calochortus* in this region and at this elevation.

It is possible that this new species has a wider distribution than is attributed to it here. Several reports of the occurrence of *Calochortus pulchellus* at some distance north of its previously known habitat need investigation, most notably that of Munz (1968) which records it in Colusa County.

Also provocative is the recent report of *Calochortus amabilis* in San Diego County (Beauchamp 1986) and the sighting of both white and yellow "globe lilies" in Tulare County (J. Searcy, personal communication) where they have not previously been reported. While no implication that these southern plants directly relate to the species introduced here is intended, they do suggest that the era of plant discovery in California has not drawn to a close.



Figure 4. *Calochortus albus*. Photo by S. Lavee.



Figure 3. *Calochortus amoenus*. Photo by S. Lavee.



Figure 5. *Calochortus pulchellus*. Photo by S. Farwig.



Figure 6. *Calochortus amabilis*. Photo by S. Farwig.

Table 1. Comparison of Selected Traits for Members of
Calochortus Subsection Pulchelli Owenby.

	<i>C. amoenus</i>	<i>C. albus</i> (coastal range)	<i>C. raichei</i>	<i>C. pulchellus</i>	<i>C. amabilis</i>
height	to 40cm	to 80cm	to 110cm	to 30cm	to 30cm
leaf & stem	green	green	glaucous and farinose	green	glaucouscent
flower*	globose rose	obovate white	obovate pale yellow	globose medium yellow	globose deep yellow
outer tepals	free and ascending	dependent and appressed	dependent and appressed	free and ascending	free and ascending
	navicular	weakly to fully navicular	flat	navicular	navicular
	shorter than inner segments	shorter than inner segments	shorter than inner segments	nearly equalling inner segments	equalling or exceeding inner segments
inner tepals	sparsely and irregularly ciliate laterally	widely and irregularly ciliate to near tips	widely and regularly ciliate to tips	closely and regularly ciliate to tips	closely and regularly ciliate to tips
	ciliation rather long and flexuous	ciliation rather long and flexuous	ciliation rather long and flexuous	ciliation short and thick	ciliation short and thick
	sparse hairs over ca 2/3 of petal	sparse hairs over ca. 2/3 of petal	moderately hairy to tips	sparsely hairy to tips	glabrous
gland	angled	angled	angled	pouched**	pouched
capsule***	winged	winged	non-winged	winged	winged

* The characterization of flower shapes is used for this comparative context. The terminology refers to the shape formed by the three inner tepals in outline, although this outline is imperfect for all the species due to the varying degrees of overlapping by the tepals.

** The margins of the glands on the exterior of the tepals are recessed, forming a pouch.

*** Information on the capsule results from a study done by Mr. Raiche of a hundred examples of each of *C. pulchellus* and *C. raichei* as well as an examination of a far lesser number for the other species by the authors. A single capsule of *C. raichei* was discovered to possess any degree of "winging," and this was barely an eighth of an inch in its development.

We wish to thank Dr. Peter Goldblatt of the Missouri Botanical Garden for his many helpful suggestions in the preparation of this manuscript.

Finally, it is with great pleasure that we dedicate this new species to Roger Raiche, a passionate plantsman, expert horticulturist, and insatiable field worker whose appetite for exploration has expanded our pleasure in the unfolding riches of California's flora.

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HIPPEASTRUM WILSONIAE A NEW SPECIES FROM BOLIVIA

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BURBANK, CALIFORNIA, USA

FRED W. MEYER
ESCONDIDO, CALIFORNIA, USA

Hippeastrum wilsoniae Doran et Meyer, species nova.

A *H. divijuliano* differt in perigonio longiore, pedicello longiore et trichomiis faucis longioribus; et in colore corollae a *H. fusco*, *H. Vargasio*, et *H. machupijchen-sio* similis sed differt in forma corollae zygomorphae.

DESCRIPTION: Plant 55-60cm tall. Bulb sub-globose 8.2cm diameter, neck 6.6cm long and 2.9cm thick. Tunics medium brown. Leaves medium green, about 8, distichous, deflexed 50-55cm long, 4.3-4.9cm wide at the middle section, 3.5cm at base, midrib slightly reddish at the base, acute at apex. Scape 37-42cm, 1.6cm thick at the base. Umbel 2-flowered, spathe bracts 7.6cm long, 1.5cm wide, acute, light green. Pedicel 5.3cm long, 4.8mm in diameter, light green. Leaves present at anthesis, upper setepalseg and upper petepalsegs held in a fairly regular actinomorphic pattern; lower setepalsegs and lower petepalseg held together below the horizontal position, perigone 11.4cm long. Ovary 1.7cm long, 0.8cm thick at base, medium oblanceolate, green, tepaltube 1.0cm long. Upper setepalseg ovate acute, 12.0cm by 4.2cm, color magenta RHC 027, top half gently reflexed, greenish-white star extending out for 5.0cm inside, lightly suffused greenish-white inside. Two upper setepalsegs, ovate acute, 10.6cm by 4.1cm, top half gently reflexed back, greenish-white star extending 5.0cm inside, lightly suffused greenish-white outside. Two lower setepalsegs oblong acute, lower half cupped inward, 10.9cm by 3.5cm, greenish-white star extending 7.0cm, suffused white at apex inside, suffused greenish-white outside. Lower petepalseg oblong acute, lower half cupped inward, 11.0cm by 2.9cm, greenish-white star extending 7.0cm, suffused white at apex inside, suffused greenish-white outside. Paraperigon, hairs light green 0.1cm long. Filament 10.3cm long, white. Style 13.0cm long, white with magenta dotting towards tip. Stigma capitate, magenta, 2.5mm. Anthers 1.8cm long, dehiscent to 0.8cm. Pollen yellow. Seeds or fruit unknown.

Bolivia: Department of La Paz, Province of Sud Yungas, near El Chaco. December, 1982. Ecker, Gielow, and Baker, Number (GI-1) type. Holotype: K. Isotype: MO (TRA) (Figure 1).

This plant comes from a river gorge area about 100km long which has produced several other species such as *H. puniceum*, *H. lapacense*, *H. yungacense*, *H. escobaruriae*, and *H. sp. nov. aff. (H. forgetii* [auct. non Worsley]), identified by Dr. Cardenas as *H. forgetii* which comes from the area around Cuzco, Peru, and now *H. wilsoniae*.

Hippeastrum wilsoniae is reminiscent of **Amaryllis divijuliana** but differs in that it has a longer perigone and pedicel; the shape of the perigone is flatter than **A. divijuliana** and has much shorter hairs in the throat. **H. wilsoniae** is similar to some of the Peruvian species such as **A. variegata** Vargas, **H. fuscum** Kraenzlin ex Engl. and **A. machupijehensis** Vargas in the coloration and somewhat in tepal position and orientation. **H. wilsoniae**, in the positioning of the lower setepalsegs and petepalseg, differs from these three in not being actinomorphic. This species is named for the late Marcia Wilson who was active in promoting the cultivation of bulbs.



Figure 1. **Hippeastrum wilsoniae** Doran & Meyer. Photo by F. Meyer

VALE

S. STILLMAN BERRY 1887–1984

WILLIAM T. DRYSDALE
RIVERSIDE, CALIFORNIA, USA

A visit to the spacious eighteen room home of Dr. S. Stillman Berry of Redlands, California, was either a delight or a horror, depending upon whether or not one's love of books transcended that of tidiness. Everywhere there were books—30,000 of them; in bookcases, both open and glass enclosed; on tables and end tables; on chairs and on the floor, stacked eight to twelve high. There was no place to sit in either the living room or the dining room, two very commodious areas; or in two libraries, one on each floor. In addition, large bookcases lined the hall between the two rooms and the stairwell to the second floor. His bedroom was fairly free of books, but correspondence had been sorted on the floor. His housekeeper apologized but explained that Dr. Berry was afraid she would dispose of something of importance to him. And what books they were! A number of them comprised what was probably the finest Darwinian library in private hands. His collection on Cephalopods was built to complement that of David Starr Jordan, first president of Stanford University, where Dr. Berry earned his doctorate. These and others were bequeathed to the Smithsonian Institution, where a small room has been dedicated to Dr. Berry's works.

I recall being instructed to go to the library and, in a bookcase against the south wall, at the east end, on the second shelf, I would find a certain title. I did. Dr. Berry was 96 at that time. He possessed a splendid copy of Gerard's *Herbal* and E. A. Bowles' copy of H. J. Elwes' *The Genus Iris*. Dr. Berry helped found the scientific library at Scripps Institute of Oceanography at La Jolla where he was paid a yearly salary of \$300 with the added opportunity of earning overtime at the rate of \$0.35 an hour, not to exceed a total of two hours per week. Some books that Scripps did not buy, Dr. Berry did.

He was named the only lifetime president of the American Association for the Advancement of Science, was a member of the Conchology Society of Great Britain and Ireland, and a Life Fellow of the San Diego Natural History Museum. At various times during his life he was awarded the man of the year for iris, daffodils, cephalopods. In 1971, he received the prestigious Round Table International Award. In 1880 his New England father had established "The Winnicook", an enormous cattle and sheep ranch comprising 100 square miles (64,000 acres), between Billings and Helena, Montana. When Stillman became ranch president in 1917, a position he held until his death, he made himself an expert on sheep and cattle; since oil had been discovered on adjacent land, he became an authority on geology and petroleum.

The Crown Prince of Japan and the Prime Minister of Sweden came to visit him. He corresponded with the Emperor of Japan on conchology. He was fluent in French, Greek, Latin, German, Norwegian, and Spanish. When he traveled he took works by Shakespeare and Dickens, an autobiography, and always included a mystery or two.

He was an authority on New England genealogy, and he was credited with hybridizing and naming more than 2700 species of plants. There are today thousands of bulbs in

his yard descended from his cross of *Tulipa clusiana* X *T. chrysantha*. During the 40's he issued a catalog of daffodils and iris hybrids—some his (*Herbertia* 10: 105), some from others.

One of his outstanding creations was *Iris unguicularis* (*I. stylosa*) 'December Joy', the delightful sweet-scented winter iris from the Mediterranean which does well here. This robust hybrid is nearly twice the size in flower and foliage than the type. He also produced a first rate multiflora-type *Amaryllis belladonna*, which I have named 'Stillman Berry.' It has bright pink flowers and an upright fan of foliage that remains erect to the very tips and sports a distinctive dark green, almost black, chevron on the neck of the foliage. Unfortunately, both of these items are scarce.

At one time in Redlands there lived two descendants of principals in the witch trials in Salem, Massachusetts: one from the judge, the other from one of the witches. Stillman Berry, with great relish, related that he was descended from one of the witches.

The most wonderful thing about Stillman, up until his last year, was his marvelous zest for living. He lost none of his enthusiasm for books, plants, people, reading, music, and lively conversation; nor was he ever at a loss for words or a botanical name. He enthused over favorite symphonic conductors and operatic performers. Though his body was enfeebled, he managed the stairs and we would go into the garden, now badly neglected but still supporting treasures, with large patches of white violets as well as blue and purple, nerines, crinum, and a dwarf crocosmia, hybrid *Amaryllis belladonna*, daffodils, species tulips, iris, and *Arum italicum*.

Dr. Berry passed away in 1984, after a series of strokes in his 97th year—in the huge home where he had worked, collected, hybridized, and studied since 1913. His will provides for the establishment of the Goodly Heritage Foundation to administer the Montana property and his other assets. The Directors have been given a relatively free hand because Dr. Berry did not feel "a dead hand should lie heavily on the future."

A NEW CRINUM FROM NEW GUINEA

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Crinum woolliamsii L. S. Hannibal, species nova

SPECIES nova subgeneri Crino affinis sed floribus fugacibus tubis tepalorum linearibus maxime longis, et ovariis parvis a consubgeneribus diversa.

DESCRIPTION: Bulb globose, 7-8cm diameter, 7cm below surface of soil with 15cm long sheathed neck 2cm diameter. Growing in full sun. Foliage, 7 leaves, lorate, semi-arching, spreading radially near ground, 65cm long by 4cm wide at midpoint, pigmented deep green with lighter depressed midrib, margins faintly dentated, apex semi-acute. Scape appearing in fall, 45cm high by 2cm diameter, slightly compressed, lightly pigmented rust-red; spathe valve bifid, small slender 5cm long. Umbel spreading widely, 13 flowers in specimen, fragrant, half of blossoms open first day and remainder the following, tepals wilting by midday; pedicels 2cm long, very slender; ovaries small 1cm long by 5mm diameter, slightly pigmented rust-red; tepal-tubes 12-14cm long, slender, linear, nonrecurving, 3-4mm diameter; tepals 8cm long by 4-5mm wide, patent, spreading, exterior segments linear, interior semi-lorate, all nonpigmented; filaments spreading widely, semi-declinate, pigmented red; anthers small, pollen yellow; style as long as tepals, declinate, pigmented; stigma small, trifid; seed unknown and offsets rarely produced.

HABITAT: Plants growing on hummocks of moist deep soil in full sun along borders of Laloki Swamp near Port Moresby Animal Quarantine Station, New Guinea. The swamp proper is a dense thicket of trees, lianas and shrubs. Some 20 plants were observed in a cleared area along the margins of this jungle swamp.

The plant name honors Keith R. Woolliams, director of the Waimea Arboretum and Botanical Garden at Haleiwa, Oahu, Hawaii. Since this botanical garden is primarily concerned with Hawaiian, Pacific, Indian Ocean, and similar island floras (particularly endangered species), Keith Woolliams and other members of the Waimea Arboretum Foundation make periodic field collection trips into various areas throughout the South Pacific and beyond. Palms and Hibiscus are among their main interests, as are Crinum, of which they have some seventy species and hybrids.

The above Crinum species was found by Woolliams on one of these field trips while botanizing the Port Moresby Laloki Swamp, Papua, New Guinea, in 1975. Since the plant could not be identified with known species, I took note of it in 1977 while at the Arboretum. The name, *C. woolliamsii*, was tentatively proposed for the discoverer. At the time we did not know the magnitude or extent of this plant population, or if it had been collected previously.



Figure 1. *Crinum woolliamsii* in cultivation at Waimea Arboretum, Oahu, Hawaii. Photo by author.

In the ten years that this *Crinum* has been at Waimea, no instance has turned up where visiting botanists have recognized the bulb, nor has a description been found of such in New Guinea or in the botanical literature. It bears some resemblance to *C. crassicaule* and *C. nerinoides* of northern South-West Africa, which suggests a primitive relationship here as well as in Asia. As a matter of proper botanical procedure, a mounted specimen has been filed with the University of California, Davis, Herbarium as a holotype. A few bulbs are being grown in the Waimea garden in Hawaii under number 75 Pl649.

No attempt has ever been made to describe the various *Crinums* of the Pacific Islands, Northern Australia, the Philippines, Indonesia, and southern Asia in a monographic fashion. One is dependent mostly on the scant information of the last century which is covered by J. C. Baker and D. J. Hooker in their publications, although E. D. Merrill cites the existence of material in the Philippines. The Waimea Arboretum and Botanical Garden intends to assemble as many of these Asian bulbs as is practical, in order to make comprehensive studies of the species and their innumerable variants. The bulbs at Waimea grow in near natural conditions whereas such tropical or subtropical plants grown in European greenhouses or Florida-Gulf conditions often fail to exhibit their normal growth habits or form.

Several typical examples can be cited. *Crinum augustum*, which is native to the swamps of Mauritius and the Seychelles, has been grown a century or more in Hawaiian gardens as the "Queen Emma Lily." The plants in circulation are sterile triploids, as has been reported by S. N. Raina and several others. But, do fertile diploids or triploids exist? Has its distribution been achieved entirely by ocean currents scattering vegetative off-sets? Is it allied to the triploid forms of *C. zeylanicum* (L.)L. in Kenya and Tanzania as reported by Inger Nordal? Only a near complete collection of these plants will clear up the genetic and inter-relationship problems.

Crinum amabile is another problem child. Herbert originally assumed it was a hybrid since it was seemingly self-sterile. Arthington Worsley reported it would set seed and could be hybridized. The difficulties lie in dated, meagre descriptions. Moreover, various members of the *C. asiaticum* alliance, when crossed with *C. latifolium* forms, produce plants resembling *C. amabile*. Yet, J. G. Baker suggests that variants exist. Collections of several such *C. amabile* variants and possible hybrids, including the 'Great Mogul of the Barbados', should clear this issue.

At present, the Gardens would appreciate adding *Crinum* specimens from Tropical East and West Africa as well as Central and South America.

NOTES ON AGAVACEAE I. A NEW SPECIES OF *MANFREDA*

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Manfreda fusca Ravenna, species nova (Figure 1)

INFLORISCENTIA congesta circa 20-flora bracteis parvis triangulari-lanceolatis instructa. Flores singuli per bractea foetidi. Ovarium oblongum viridescens ad 12-17.8mm longum et 6.6mm latum. Perigonium 37mm longum extus glauco viride. Tepala usque 14.2mm connata parte libera lineari-lanceolata in facie adaxiali fusco-ochracea ad apicem tuberculato-apiculata, exteriori- superius prominens 15mm longum et 4mm latum cum tepalo interiore etiam prominenti ad 14.8mm longo et 5mm lato contiguum, lateralia patentia ad 16mm longa et 5mm lata uno exteriori et uno interiore, inferiora abrupte reflexa uno exteriori ad 15.2mm longo circa 4.8mm lato et uno interiore ad 15mm longo circa 5.8mm lato. Filamenta lineari-subulata leviter complanata sordide albo-viridescens minute fusco striolata apicem versus sparse piloso-glandulosa majora 3.9-4.2cm longa. Anterae versatiles oblongo-lineares dorsifixae subrectae vel arquatae 11-15mm longae connectivo nigro-purpureo vel nigro; pollen lutescens. Stylus colore ut filamentis ante dehiscens antherarum reflexe tortilis post dehiscens subrectus vel leviter arcuatus usque 57mm longus. Stigma capitato-trilobum.

Plant up to 1.50m high. Rhizome vertical 20-23mm thick. Leaves several, sprawling, narrowly lanceolate, channelled, the abaxial face carinate, slightly scabrous in texture, ash-green, 30-50cm long, 22-30mm broad. Flower stem stiff, with a few leaves below, the rest gradually reduced upwards to bracts, these being rather distant. Inflorescence crowded ca. 20-flowered, the bracts here quite small, lanceolate-triangular, 2-9mm long. Flowers single in each bract, fetid. Ovary oblong, greenish, 12-17.8mm long, 6.6mm wide. Perigone 37mm long, externally glaucous-green. Tepals joined in a tube for 14.2mm, free portion linear lanceolate, the adaxial face dark brown, the point tubercled-apiculed; the upper-outer one prominent, 15mm long, 4mm broad, contiguous to one of the inner tepals, which is also prominent and 14.8mm long, 5mm broad; the lateral ones spreading, an outer one and an inner one, to 16mm long, 5mm broad; lower ones abruptly reflexed, an outer one 15.2mm long, 4.8mm broad, and an inner one 15mm long, 5.8mm broad. Filaments linear-subulate, slightly compressed, a dirty, greenish-white with diminutive dark streaks, sparsely glandular-pilos, the longer 39-42mm long. Anthers versatile, linear-oblong, dorsifixed, almost straight or curved, 11-15mm long, the connective purplish-black or black; pollen yellowish. Style the same color as the filaments, to 57mm long, reflexed and twisted before the anther dehiscence, almost straight or slightly curved afterwards. Stigma capitate-trilobed (Figure 1).

HABITAT: In sandy plains near a bridge, between Chimaltenango and Comalapa, Guatemala; it grows near **Echeandia reflexa** (Cav.) Rose (two forms).

COLLECTIONS: Culta in Bonaria ex rhizomas in arenosis inter Chimaltenango et Comalapa Guatemala collectis; Ravenna 325, 12-II-1964 (Herb. Ravenna, type).

The species was cultivated by me several years ago. It is the second species of the genus in the Guatemalan flora (see Standley & Steyermark, 1952). The other, **Manfreda brachystachya** (Cav.) Rose, flowered recently in my experimental collection, from rhizomes collected near Sipacapa, dept. of San Marcos. It is a stouter, taller plant, with a much more elongate inflorescence; the green flowers are more spaced and in higher number. It should be noted that the original spelling was **brachystachya**, and not "brachystachys," as earlier authors (e.g. Baker, 1888) have written.

Manfreda Salisb., was reduced to a synonym of **Polianthes** L. by Shinnars (1966). In my opinion, this is a mistake. The former genus is distinguished by the long stamens exceeding the perigone, which is a constant character. Both genera are otherwise rather similar. The status of the close genus **Prochnyanthes** S. Wats. appears as doubtful and should probably be merged in **Manfreda**.

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Figure 1. *Manfreda fusca* Ray., as cultivated in Buenos Aires by the author. Photo by the author.

GORDON MCNEIL — AN AUTOBIOGRAPHY

[The following is a very brief autobiography supplied in a letter by Gordon McNeil shortly before his death. His involvement with bigeneric hybrids has been somewhat controversial, but this should not detract from his proven contributions to horticulture and plant conservation—Editor.]

MY MOTHER died in 1914, when I was six years old. I was brought up by an aunt in Galloway, Scotland. She was the eldest of a family of eight, and put three of her brothers through university, where they took their degrees in medicine.

One of the brothers, my father, became a surgeon in South Africa. His youngest brother became a pediatrician in Scotland. The eldest doctor, after serving as a medical officer to a Boer Command in the war against Britain, died at a rather young age in Johannesburg the year I was born, 1908. The First World War came as a welcome relief to my father who joined the Cape Corps as their Medical Officer and sent my two brothers and me to Galloway to be brought up by his sister, Martha.

She interested me in plant collecting, but it was not until after the Second World War, in which I served in my father's old regiment, that I began seriously collecting plants.

On holiday at Morgan's Bay on the eastern Cape coast, I made my first intergeneric hybrid. This **Nervigia**, which sets good seed, produces two types of plant, of which the first has twisted leaves like one of the parents, **Nerine krigei**. The second type has broader less twisted leaves suggesting **Brunsvigia** genes.

More recently since my acquisition of the Blackbeard **Clivia** in 1962, I have been making more and more intergeneric hybrids in the Amaryllidaceae.



Figure 1. Gordon McNeil at his home in North Transvaal, Republic of South Africa.

BULB PRODUCTION IN NEW ZEALAND

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PRODUCTION OF *HAEMANTHUS ALBIFLOS* FROM LEAF CUTTINGS

DURING the autumn of 1983 my stock of *Haemanthus albiflos* got very low and, having little success with seed production, I decided to try leaf cuttings. I detached three mature leaves and dipped the base in softwood hormone powder, then set each leaf into a pot of sand. These whole-leaf cuttings set a few bulbs at the base—about 20 in all.

In the autumn of 1986, about early April, I decided to try this technique again, this time cutting the leaf into three parts and using softwood hormone powder. The cut leaves were set into a tray of sand leaving them under the propagation bench in quite a cool, shady spot.

In August, 1986, I potted up a few. The top portion had the most bulbs, the middle fewer, and the bottom the least bulbs. I potted 67 strong bulbs, each with a leaf growing and a further set of small bulbs still attached to the top and middle leaf portions; a possible 80 bulbs in all. I concluded that this is a fast way of increasing *Haemanthus albiflos*.

Though I did not use one of the choice *Haemanthus*, perhaps this method could be used for other species. I haven't other *Haemanthus* material available at the present time, except for a vigorous form of *H. coccineus*, which hasn't performed as yet, but only rotted. Perhaps the timing needs to be just right!



Figure 1. *Haemanthus albiflos* bulbs developed from leaf cuttings showing lower portion on left, middle portion in center, and upper portion on right. Photo by author.

CULTIVATION OF A RARE, PALE LEMON FORM OF *VELTHEIMIA CAPENSIS*

DURING 1980, I exchanged one-fourth pound of *Ixia viridiflora* for 10 *Veltheimia* seeds. I was told that they were of a yellow type and hard to grow. The seeds grow readily in a light mix of *Pinus radiata* bark and sand and were potted after 1 year into 6 inch pots. In their third season, I potted them into 2-gallon buckets just to push them on a bit, using plenty of dried blood and some potash.

One plant grew large enough to make a small bud which flowered pink! Disappointed, I put them under the bench and the following season they sulked and just grew a little with no flowers.

Last season I repotted them. Some had a smaller offset bulb—but they all had come out very strong and sent up a total of four stems of pure lemon flowers and, indeed, were beautiful. This season they are in full flight with plenty of strong stems.

I hope they will set a few seed since none set even after hand pollination last year, though I crossed them onto pink and had some seeds set.



Figure 2. Yellow form of *Veltheimia capensis*. Photo by author.

HYMENOCALLIS × 'DAPHNE'

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ONE OF the most magnificent of all bulbous plants is the hybrid *Hymenocallis* × 'Daphne' (Figure 1). It resulted from the difficult cross of the deciduous *H. (Ismene) calathina* and the evergreen *H. speciosa*. It combines the size of the staminal cup of the former with the exceptional elegance of the latter so that it appears to be a glorified *H. speciosa*. Not only are the flowers exquisite, they distill a scent that is both ravishing and powerful enough to be enjoyed some distance away.

It is evergreen. The foliage more closely resembles that of *H. calathina* with long narrow, light-green leaves, but there is a definite constriction of them at their base which derives from the other parent. It will flower out-of-doors in Southern California in a spot sheltered from the cold and sun but with good light as with *H. speciosa*. 'Daphne' was, according to the "Dictionary of the RHS", "raised by Mr. van Tubergen of Haarlem before 1900."

Both parents of this hybrid can be grown out-of-doors in Southern California. *H. calathina* flourishes here and can be left in the ground all winter, even though it is deciduous. *H. speciosa* is marginal out-of-doors and must be placed carefully in the warmest and most sheltered areas of the garden. They will flower regularly in early summer with their snow-white, fragrant blossoms, but seed is unlikely to develop outside except in the warmest coastal areas. Under glass they set their large, green seeds easily and generously. It is from this parent that 'Daphne' derives its great elegance. The dark green foliage is on the order of *Eucharis grandiflora* and is highly ornamental.

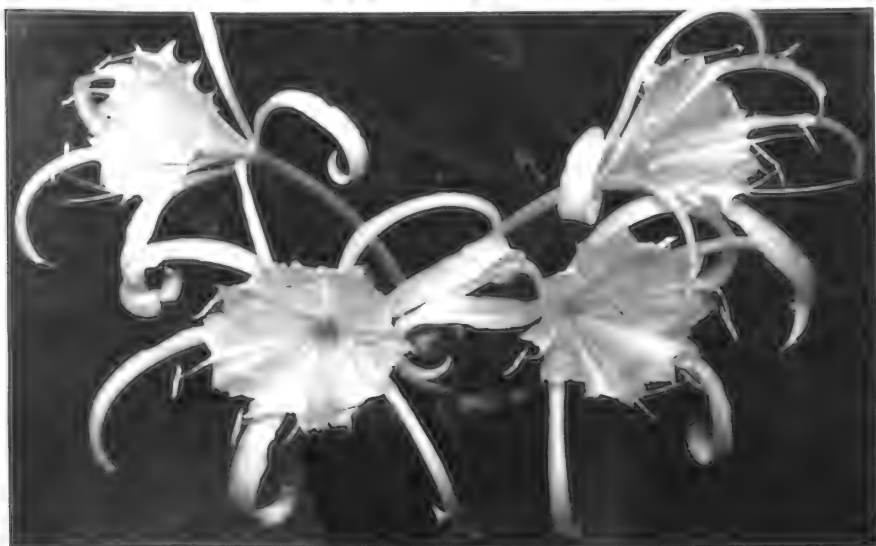


Figure 1. *Hymenocallis* 'Daphne'. Photo supplied by author.

HIPPEASTRUM HYBRIDS

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A program to evolve new heat resistant hybrids suitable for the North Indian Gangetic plains conditions, is in progress. Nearly 25 hybrids have been developed from different combinations and are under assessment. The following hybrids were found promising and are described below:

'SAMRAT'

'Samrat' (Figure 1) has been raised from a cross between cv. 'Bridegroom' (4x) × cv. 'Coquette' (4x). This hybrid produces 1-2 tall scapes (45-50cm long) with 3-4 large (16.0-18.0cm across), reflexed and belladonna-type flowers. The color of the flower is Dutch vermillion (17/2) with a marked greenish throat at the base. There are 6-8 white, parallel veins spreading lengthwise over the perianth.

'KIRAN'

'Kiran' is a triploid and has been raised from an intervarietal cross between cv. 'Ganymede' (4x) × cv. 'Romeo' (2x), the two varieties of *H. vittatum*. The flowers of this hybrid are large (18-20cm across), white, and have a marked reginaoid influence. Like its female parent (cv. 'Ganymede'), the flowers of this hybrid also have 6-8 scarlet colored (19/1) veins running parallel to the midrib of the perianth (Figure 2).

'JYOTI'

This hybrid was raised from a cross between cv. 'Snow White' (2x) × cv. 'Firefly' (2x). The flowers of this hybrid are semi-double. Morphologically, all the hybrid seedlings are very vigorous, producing 4-6 dark green leaves, 3-5cm broad and 35cm long. Scapes were 45-55cm tall with 2-3 beautiful flowers each. Flowers are bell-shaped (10.0cm across) and crimson (22/2) with deeper-colored veins radiating toward the apex. The base of the flower is green, but white upward. In this hybrid, 3 styles are modified into a perianth-like structure with the stigma attached on the apex (Figure 3).

Sexually, this form is both male and female sterile, but offers a noteworthy characteristic of easy propagation by bulblets. The plants spread rapidly through daughter bulblets which are produced very freely, whenever they are grown in well-drained, sandy loam soils.

'POONAM'

This hybrid was raised from a cross between cv. 'Snow White' (2x) × cv. 'Aphrodite' (2x). Out of numerous seeds produced, only one plant survived. The hybrid usually produces 1-2 scapes with 2-4 large (12.0-14.0cm across), reflexed and belladonna-type



Figure 1. 'Samrat'. All photos taken by author.



Figure 2. 'Kiran'



Figure 3. 'Jyoti'

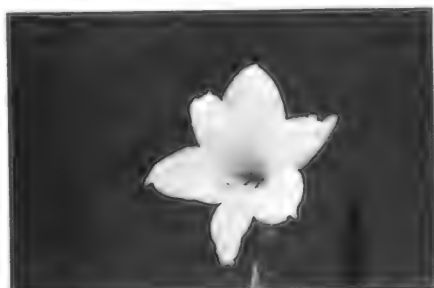


Figure 4. 'Poonam'

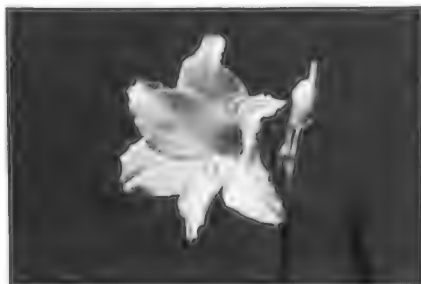


Figure 5. 'Deepali'

flowers. The flowers of the hybrid 'Poonam' are completely white with a marked golden yellow throat at the base (Figure 4).

The plants have evergreen foliage. Perigone is slightly triangular or compressed. Perianth lobes are recurved with entire margins. A paraperigone is present but inconspicuous. The stamens are shorter than the perigone and remain inserted within the perigone. This hybrid is sexually sterile and does not produce seeds either by self- or cross-pollination.

'DEEPALI'

This hybrid was raised from a cross cv. 'Saturn' (2x) × cv. 'Snow White' (2x). The plant produces 2-4, small (10-12cm across) belladonna-type flowers. The flowers are white, but flushed with magenta (22/1) patches spreading throughout the perigone (Figure 5). The plant is evergreen and produces dark green foliage. This is a female sterile plant but crosses as a pollen parent freely.

NEO-CENTRIC ACTIVITY IN *HEMEROCALLIS* LINN.

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CHROMOSOMES have a constant region known as centromeres. The centromere during cell division provides a junction between the chromosomes and spindle fibres at anaphase separation.

The appearance of sites having centromeric activity other than the centromere may be considered as an unusual act of the cell. This phenomenon is known as neo-centric activity. Such a case with a disturbed centromeric activity showing a diffused state or terminalized actions on meiotic metaphase I chromosomes has been discovered in a clone of *Hemerocallis fulva* L. (Voucher specimen 4/62). In this hybrid, instead of normal bivalent pairing (Figure 1) at meta I, bivalents were observed showing neo-centric activity at their ends (Figure 2). In these cells, the chromosomes appear fragmented with their broken segments.

Neo-centric activity has been observed in a number of plants like *Secale* (Prakken and Muntzing, 1941; Östergren and Prakken, 1946; Rees, 1955; Hayward, 1962; Vinikka, 1984), *Zea mays* (Rhoades and Vilkomerson, 1942; Rhoades, 1955; Mello-Sampayo, 1961), *Bromus* (Walters, 1952), *Phalaris* (Hayman, 1955) and *Lilium* (Zohany, 1955).

In *Zea mays*, this phenomenon was studied extensively by Rhoades and Vilkomerson (1942) and Rhoades (1955). They believed that neo-centric activity in *Zea mays* is due to hybrid origin, as this was more pronounced in plants where heterozygosity prevailed in a chromosome pair (10th pair) of its somatic complement. This pair consisted of a knobbed and a knobless chromosome in contrast to the normal pair of knobless homologous chromosomes.

Rhoades (1955) crossed a plant (having a knob on the standard chromosome) which had previously displayed neo-centric activity with a heterozygote having a paracentric inversion in order to obtain acentric fragments. In the progeny, chromosomes associated only with centromeres were observed showing neo-centric activity while acentric fragments were unaffected. Furthermore, knobs in the normal chromosome had shown this activity, but knobs in the acentric fragments did not. The number of centromeric sites were also in accordance with numbers of knobs on a normal chromosome. This indicated that a centromere produces some material which migrates through the chromosome to the knobs and the knobs in turn induce neo-centric like activity in the chromosome.

It is, therefore, concluded that the centromere is very important in control of the chromosomes by a canalised movement. Darlington (1965) believed that the centromere usually produces a diffusible enzyme having the same capacity for generating spindle fibres as the centromere itself.

Neo-centric activity in the pollen mother cells of *Lolium* has also been induced artificially by heat (Jain, 1960). Situations which had induced neo-centric activity in the *Hemerocallis* has not yet been clarified. However, the heterozygosity in the mitotic complement of this taxon seems to be responsible for such anomalies.

ACKNOWLEDGEMENTS

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Figure 1. Meiotic chromosomes of *Hemerocallis fulva* showing eleven pairs at Metaphase I. x 1100.



Figure 2. Meiotic chromosomes of a *Hemerocallis fulva* clone showing neo-centric activity at Metaphase I. x 1100.

GROWTH AND FLOWERING RESPONSES OF *POLIANTHES TUBEROSA* L. TO STORAGE, TEMPERATURE AND DURATION OF TREATMENTS

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P*OLIANTHES tuberosa*, or tuberose, especially the cv. 'Single', is an important commercial crop of India. Many aspects of this crop have not been studied properly. One such aspect is the effect of temperature and duration of storage on bulbs, on which no work was done until recently (Biswas and Mitra, 1982). The present experiment was conducted to throw further light on this aspect.

EXPERIMENTAL PROCEDURES

The experimental plants were grown in 30cm diameter earthen (clay) pots which were arranged following a completely randomized design. There were 12 replications (pots) per treatment. Freshly harvested tuberose 'Single' bulbs of uniform size (3cm diameter) were stored at 0°, 4°, 10°, and 30° C (room temperature) for 0 (control), 4, 6, and 8 weeks. The bulbs for storage were packed in polyethylene bags. After the storage, the bulbs were soaked in 0.2% Captan solution for 15 minutes, air dried and planted in clay pots. The control bulbs were treated the same way. Observations were taken of 11 parameters. The duration of flowering was noted from the date of opening of the first floret in a spike. The bulbs were harvested and data were noted after the completion of flowering at the end of the first season, i.e. 10 months after planting. The data were interpreted statistically by the Analysis of Variance technique (Federrer, 1955).

RESULTS

No significant effects were observed for the number of leaves per plant, length of rachis, number of florets per spike, or number of bulblets produced per plant. The other parameters influenced significantly are presented in Table I.

Tuberose, being a tropical plant, its bulbs could not stand 0°C for 6 or 8 weeks, and did not sprout when planted out.

After 6 and 8 weeks of storage, increasing the storage temperature improved the height of plants. Similarly, as the duration of storage was increased, the height of plants progressively decreased at all temperatures. Similar results were reported by Biswas and Mitra (1982).

Table 1. Significant Effects of Different Bulb Storage Temperatures and Duration on Growth, Flowering, and Bulb Production in Tuberoses

Treatment	Height of Plant (cm)	Number of Flowering-size Bulbs/Plant	Total Weight of Bulbs and Bulblets/Plant	Days of First Flower Opening From Date of Planting	Number of Spikes/Plant	Length of Spike (cm)	Longevity of Spike in Field (Days)
Control (without storage)	35.0	4.5	113.6	155.4	2.0	69.0	18.5
4 Weeks Storage at							
0° C	36.9	3.0	117.0	187.4	1.5	86.3	20.0
4° C	33.5	1.7	89.7	176.1	1.8	72.4	18.8
10° C	37.7	3.0	122.1	240.9	1.4	82.0	17.1
30° C	36.2	3.5	147.7	225.0	1.2	87.2	20.0
6 Weeks Storage at							
0° C	All	Bulbs	Rotted	During	the	Storage	Period
4° C	20.8	1.5	54.5	225.0	1.4	69.0	15.3
10° C	27.7	3.3	82.7	261.7	1.4	79.1	16.6
30° C	30.2	4.5	145.0	143.9	2.9	75.8	16.1
8 Weeks Storage at							
0° C	All	Bulbs	Rotted	During	the	Storage	Period
4° C	22.2	2.3	86.6	212.9	1.5	69.5	15.7
10° C	24.0	4.0	106.9	276.0	1.4	79.7	18.5
30° C	26.9	3.3	89.0	123.0	3.5	65.0	13.0
C.D. (Critical Difference) at 5%	3.9	1.5	38.3	44.4	0.8	6.0	2.4

The flowering-size bulb production was influenced positively by 30°C and Biswas and Mitra (1982) indicated similar results.

Days for first flower opening was reduced and number of flower spikes per plant improved when bulbs were stored at 30°C for 6 or 8 weeks compared to low temperature storage. The results confirmed the earlier findings on the same crop by Biswas and Mitra (1982).

However, the length of spike was adversely affected by warm storage temperature, and as a result of this, the spikes produced from bulbs stored at 30°C for 8 weeks, were shorter by about 10cm than the control.

Longevity of flower spike in the field was significantly less when bulbs were stored for 8 weeks at 30°C, compared to control.

SUMMARY

Freshly harvested bulbs of tuberose cv. 'Single' were stored at 0°, 4°, 10°, and 30°C for 0 (control), 4, 6, and 8 weeks in polyethylene bags and then planted in 30cm diameter earthen pots. All bulbs stored at 0°C for more than 4 weeks rotted. Irrespective of duration, low-temperature (4°C or 10°C) storage adversely affected plant growth and flowering. However, storage on bulbs at 10°C showed some improvement in the quality of the flower spikes. Storage at 30°C for 6 or 8 weeks advanced flowering and increased the spike yield, but the spike quality deteriorated, especially when the storage lasted for 8 weeks. Low-temperature (4°C) storage adversely affected the yield of flowering-size bulbs. The control bulbs and those stored at 30°C for 6 weeks produced the maximum number of flowering-size bulbs.

ACKNOWLEDGMENT

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IMPORTANCE OF NITROGEN NUTRITION FOR *POLIANTHES TUBEROSA* L. IN INDIA

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TUBEROSE, *Polianthes tuberosa* L., belongs to the family *Amaryllidaceae*. In India, four horticultural cultivars of this flower are available which are known as 'Single' (Figure 1), 'Double' or 'Pearl' (Figure 2), 'Semi-Double', and 'Variegated' (Bankar and Mukhopadhyay, 1980). But the cultivar 'Single' is more widely cultivated than others (Sadhu and Bose, 1973). This flower is commercially cultivated for the supply of cut flowers for vase decoration, making women's floral ornaments, or for religious ceremonies. The major growing areas are around Calcutta, near Bangalore City in the state of Karnataka, surrounding areas of Pune in Maharashtra state, and in and around Coimbatore in Tamil Nadu (Sharga, 1977). Pure tuberose absolute extract is perhaps the most expensive natural flower oil used in high-grade perfumery (Sharga, 1977 and Frances, 1972).

Several factors are responsible for the proper production of tuberose spikes (inflorences). One of these is climate. A warm humid climate is ideally suited for proper flower production. Mild weather conditions which are neither extremely hot nor cold, as prevailing in Bangalore, India, is also very suitable for the production of this flower. If the winter temperature goes below 10°C, the spike production declines, and in the event of frost, the above-ground parts are killed.

The growth and spike yield of tuberose is highly dependent on proper feeding. There are conflicting views regarding the feeding of tuberose. According to one view (Rameswar, 1976), tuberose is a heavy feeder, while others (Sadhu and Bose, 1973) opine that excessive amounts of nitrogenous fertilizers are not good for this plant. Randhawa and Mukhopadhyay (1986) stressed the need of nitrogen nutrition for growth and flowering. A number of research findings by different groups of research workers from various parts of India give a convincing picture about the need to feed this crop with a reasonable quantity of nitrogenous fertilizer.

Why crops in India respond well to nitrogen application may partly be explained by the poor nitrogen status of Indian soils. The Indus alluvium and Gangetic alluvium soils of north, central and eastern Indian regions contain 0.05 and 0.04 percent nitrogen, respectively. The red soils of southern India contain only 0.03 percent and the laterite soils, 0.04 percent. It is only the black cotton soils of western and central India which contain slightly higher nitrogen percentages of between 0.05 and 0.06. Jenny and Roychoudhury (1960) attributed the low levels of nitrogen in Indian soils primarily to warm climate and, secondarily, to cropping pattern.



Figure 1. Single cultivar of *Polianthes tuberosa*. Photo by author.



Figure 2. Double cultivar of *Polianthes tuberosa*. Photo by author.

APPLICATION RATE

Various workers have studied the quantity of nitrogen required for a good tuberose crop. Mukhopadhyay (1981), Mukhopadhyay and Bankar (1978), and Bankar and Mukhopadhyay (1985) used between 50kg and 350kg of nitrogen per hectare in southern India and found that increasing the application beyond 250kg did not have much additional beneficial effect on growth and flowering. However, it was observed (Bankar and Mukhopadhyay, 1985) that per hectare yield of spike improved substantially when nitrogen application was enhanced from 200kg to 350kg. But those authors felt that further studies were needed to find out the economics between increase in fertilizer application and the additional flower yield obtained. The results of Najan *et al.* (1980) also indicated that application of 200kg/ha of nitrogen gave the highest flower yield and monetary return. However, other research results from the north (Singh *et al.*, 1976) indicated that even an application of 120kg/ha of nitrogen increased flower yield by 6.4 percent over a rate of 80kg/ha.

In an earlier work, Singh (1972) observed that for saline and alkaline soils of the north, 40kg/ha of nitrogen was sufficient for good flower yield. Mitra *et al.* (1979) used up to 80kg of nitrogen per hectare in eastern India and obtained satisfactory results in terms of flower yield with an application of only 75kg, whereas Bose (1984) concluded that 150 kg/ha nitrogen was optimum for spike yield for eastern India. The results quoted above are from the southern, northern, and eastern parts of India and give a comprehensive picture about nitrogen requirements of this crop in different zones.

APPLICATION TIMING

The time of application of nitrogen has also been studied. A review of available literature (Jana *et al.*, 1974; Bankar and Mukhopadhyay, 1980; Bhattacharjee *et al.*, 1979); Mukhopadhyay, 1981) indicated that normally nitrogen is applied in two split doses — one of which is given just before planting and the other at about the time of flower initiation. An elaborate experiment was recently conducted by Mukhopadhyay and Bankar (1985) to find out the exact stages of fertilizer application in tuberose cv. 'Single'. Nitrogenous fertilizer was added in four stages of growth, viz. (1) before planting, (2) 30 days after planting, (3) 60 days after planting, and (4) 90 days after planting (i.e., at flower initiation). It was added in one full dose or 2, 3, or 4 split doses, at different stages of growth. It was observed that when nitrogen was added at a rate of 20g/m² in three equal split doses, once before planting followed by one application each at 30 days and 60 days after planting, it produced the most beneficial results. This mode of application of nitrogen was found to be good for increasing plant height and number of leaves produced per plant. Further, the yield of spike and other floral quality parameters such as length of spike, length of rachis, and number of florets borne in each spike were also improved significantly. Although the research workers cited above did not observe any set pattern regarding the doses suitable for bulb production, they concluded that split application of nitrogen is good for bulb yield, especially when one of the split doses is applied at an advanced stage of growth. Nanjan *et al.* (1980) applied 200kg of nitrogen per hectare in four equal doses during a full year.

Several research findings are available to show the effects of two split doses of nitrogen application on vegetative growth. Mukhopadhyay and Bankar (1978), Jana *et al.* (1974), and Bhattacharjee *et al.* (1979) reported that nitrogen applied in two doses improved vegetative growth.

FLOWER YIELD

Bhattacharjee *et al.* (1979) reported that high doses of nitrogen delayed flower bud appearance. On the other hand Chikkapapanna (1976) studied the influence of nitrogen nutrition in advancing the date of flower initiation. The works of Mukhopadhyay (1981) and Mukhopadhyay and Bankar (in press) give detailed information on effects of nitrogen on flower yield and other floral parameters.

In a two-year experiment, it was observed that nitrogen applied at 20g/m² improved spike yield by 21.42 and 57.26 percent over control during the first and second year of the experiment, respectively. Similarly, in plants receiving 20g/m² nitrogen, the length of spike increased by 25.26 and 22.96 percent, length of rachis by 21.85 and 15.51 percent, and number of florets per spike by 7.12 and 20.69 percent over the control in the first and second year of the experiment, respectively. The importance of nitrogen in improving flower yield has also been emphasized by Singh *et al.* (1976). They observed that increase in flower yield at 120kg/ha was 6.4 and 14.1 percent more over 80 and 40kg of nitrogen/ha. Several other workers studied the importance of nitrogen in improving flower yield of tuberose (Gopalakrishna, 1962; Motial, 1973; Jana *et al.* 1974; Bhujbal and Wavhal, 1978; Bhattacharjee *et al.*, 1979; and Mitra *et al.*, 1979). Nanjan *et al.* (1980) also concluded that nitrogen application of 100kg/ha alone resulted in an increase of 16.1 percent flower yield over the control, where no nitrogen was applied. The improvement in the number of florets produced per spike as a result of nitrogen nutrition has been studied by other workers also (Jana *et al.*, 1974 and Bhattacharjee *et al.*, 1979).

The usefulness of nitrogen in increasing the duration of flowering has also been studied by various workers. While Mukhopadhyay (1981) observed only marginal benefits on the field and vase life of flowers, Bhattacharjee *et al.* (1979) and Bankar and Mukhopadhyay (1985) noticed substantial improvement in the duration of flowering.

BULB YIELD

The influence of nitrogen in increasing bulb yield has been reported by various workers. Mukhopadhyay (1981) observed that added nitrogen improved only the yield of bulblets (less than 2.0cm diameter) and not the flowering-size bulbs. However, Jana *et al.* (1974) and Bose (1984) reported that nitrogen fertilization significantly improved bulb yield.

PHOSPHORUS AND POTASSIUM

In contrast to the wide influence of nitrogen on growth, flowering, and bulb production, the effects of phosphorus and potassium are not as glaring. Mukhopadhyay (1981) observed that in a two-year trial the plant height was improved in both years, while the number of leaves only improved in the second year as a consequence of phosphorus

application. He observed that phosphorus did not influence flower yield, but increased the length of spike and number of florets produced per spike. However, Jana *et al.* (1974) observed that deficiency of phosphorus suppressed flowering. The effect of potash is still limited to only a few parameters. The only parameter which was found to be influenced positively by the application of potash is the number of florets produced per spike (Mukhopadhyay, 1981 and Jana *et al.*, 1974).

MODE OF NITROGEN INFLUENCE

The favorable effect of nitrogen in promoting the growth and flowering may be explained from the fact that nitrogen functions as a necessary component of such biologically important molecules as protein, amino acids, coenzymes, etc. If nitrogen is accelerated, synthesis of amino acids and chlorophyll is increased. As such, the reduction in growth of plants due to nitrogen starvation has been ascribed to the reduction of protein synthesis and consequent reduction in meristematic activity (Arney, 1952). According to Hillman and Galston (1961), shortage of either nitrogen or phosphorus results in the reduction of the auxin level in the experimental plant, which in turn affects growth. Further, Goldback *et al.*, (1975) observed that any nitrogen deficiency in the roots increased the content of ABA of shoots, which might be responsible for the decrease of gibberellic acid content of shoots (Rajgopal and Rao, 1974). Any deficiency of gibberellic acid will have an adverse effect on growth or flowering.

SUMMARY

In conclusion, a review of Indian literature on the nitrogen nutrition of tuberose tends to indicate that it is principally nitrogen which widely influences the growth, flowering, and bulb production, while the effectiveness of phosphorus or potash is seen only on a few plant parameters. Similar views were expressed earlier by Militiu *et al.* (1970) and Mukhopadhyay (1981).

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GLYPHOSPERMA, A SYNONYM OF ASPHODELUS

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ABSTRACT

EXAMINATION of an isotype of *Glyphosperma palmeri* S. Wats., suggests that it represents a synonym of *Asphodelus fistulosus* L. (Asphodelaceae). The monotypic genus *Glyphosperma* S. Wats., becomes, therefore, a synonym of *Asphodelus* L. The former has been placed in the Anthericaceae by recent authors (Dahlgren *et al.*, 1985). *A. fistulosus* is now reported as naturalized in Chile.

A survey of the New World genera of Anthericaceae (Ravenna in prep.) led me to request on loan from the New York Botanical Garden (NY) an isotype specimen of *Glyphosperma palmeri* S. Wats., the type, and sole species of its genus. When it reached me, a close examination revealed the plant to be: *Asphodelus fistulosus* L. *Glyphosperma* is cited by Dahlgren *et al.* (1985: 185) as belonging to the Anthericaceae.

Asphodelus fistulosus had been reported by C. T. White (1920), as "a common weed in many countries." According to him, it occurs in nearly all the states of Australia, and "it has become one of the worst weeds of Toowoomba district."

I had *A. fistulosus* under cultivation in Buenos Aires (Argentina), and introduced it in the Botanic Garden of Castelar, where it showed a clear trend of escaping from the collection. The species had already established itself as adventitious in the near-north Atacama province of Chile. It would seem obvious now that the same had happened long ago in northern Mexico.

ASPHODELUS Tourn. ex Linnaeus, Syst. Veg. ed. 1, 1735; Sp. Pl. ed. 1:309, 1753.
Type-species: *A. ramosus* L.

Synonym: *Asphodeloides* Moench, Meth.: 634, 1794. — *Clausonia* Pomel, Mater. Fl. Atlant.: 1, 1860. — *Verinea* Pomel, loc. cit. — *Gethosyne* Salisbury, Gen. Pl. Fragm.: 72, 1866. — *Ophioprason* Salisbury, loc. cit. — *Glyphosperma* S. Watson (syn. nov.), Proc. Amer. Acad. Sci. & Arts 18: 164, 1883.

ASPHODELUS FISTULOSUS Linnaeus, Hort. Cliff.: 83, 1734; Sp. Pl.: 309, 1753.

Distribution

Portugal, Spain, southern France, probably Italy, Greece, Syria, Arabian peninsula, Afghanistan, northern India, northern Africa, naturalized in Mexico, Chile, Australia, and possibly other countries.

Collections

Mexico, Coahuila, Saltillo; E. Palmer 1320, 1/15-IV-1880 (NY, isotype of *Glyphosperma palmeri* S. Wats., Figure 1). Chile, prov. Atacama, cerca de Huasco,

orilla oriental del camino; sine coll. nr. 1982, 11-VIII-1965 (Herb. Fac. Agr. Santiago, SGO). Spain, Barcelona, terres incultes; E. Bourgeau, Pyrenees Espagnoles Nr. 160, Avril (color transparency from K).

ASPHODELUS FISTULOSUS L. ssp. NILOTICA Ravenna, subspecies nova

A subspecies typica habitu graciliore et foliis caulibusque scabridule piloso-papillois differt.

Distribution

Northern Africa, in Alger and Egypt.

Collections

Alger, circa Oran; Boissier et Reuter, 1849 (SGO 3700). Egypt, prope Gizeh, in ripa orientali; Ehrenberg, I-1820/1826 (SGO 3697 holotype, B isotype ?). Ibidem, in ripa; Ehrenberg (SGO 3698, B ?).

Uses

According to C. T. White (op. cit.), a strong glue, suitable for book-binding, may be extracted from the roots of the species. This same product is obtained from some other European species (Negri 1948:49), such as **A. ramosus** L. and **A. albus** Mill. The roots may also produce alcohol. Also, after the knowledge of White, the seeds contain a good drying oil. He also indicates that the species is commonly used in India as a vegetable (cooked), and the seeds are turned into flour. He cites "The Agricultural Ledger of India," 1902, No. 7, as dedicated to the plant and its uses.

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Figure 1. Photo of isotype specimen of *Glyphosperma palmeri*. Photo by New York Botanical Garden.

HAEMANTHUS/SCADOXUS

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WE HAVE had some years now—since 1976—to get used to the division of *Haemanthus* in two, with the stalked, ribbed, thin-leaved species being elevated to a separate genus, *Scadoxus*. These are principally centered in tropical Africa, with only a few representatives in southern Africa. Those plants with two flat, ground-hugging, succulent leaves remain as *Haemanthus* and are largely confined to southern Africa, and are easily accommodated in the California garden.

With the publication of *A Revision of the Genus Haemanthus* by D. Snjman in 1984, we find it is not all that simple, and problems are created for the horticulturist because of lumping as well as grouping. More important than appearance in deciding classification, was the determining of chromosome number; 16 in *Haemanthus* and 10 in *Scadoxus*.

Only two white *Haemanthus* are recognized. *Haemanthus deformis* and all the rest disappear into synonymy under *H. albiflos*. Among many others, these include *H. albomaculata*, *H. pubescens* ssp. *albiflos*, *H. burchellii*, and *H. brachyphyllus*.

I suspect many of these names will continue now as varietal names rather than species. How else is the collector to distinguish between a plant he covets and is willing to pay good money for and a nondescript, common type? Because of this, John Weathers' 1911 *Bulb Book* remains my favorite reference book of bulbs. He may have gone overboard on horticultural differences, but to me this is preferable to the lumping of forms by botanists. I want a duplicate of the plant I admire, not one of a grex.

Another problem created is that *Haemanthus katherinae* is now *Scadoxus multiflorus* ssp. *katherinae*. One must be sure one's suppliers distinguish between the species and the subspecies. *Scadoxus multiflorus* thrives in Florida because of the warm nights. In Southern California, where cool nights prevail even during most summers, it begins to diminish in size almost immediately. Out-of-doors it is unlikely to survive the first winter. On the other hand, *S. katherinae* does not like warm nights and thrives in Southern California.

Haemanthus carneus is also shade-loving and possesses a pair of leaves which are prostrate when fully developed but are semi-erect in their early growth. There are fewer flowers than with *H. coccineus*, but they are larger and flesh-colored. They appear in late summer or early fall.

Other species such as *S. natalensis* and *S. nelsoni* are not really successful in the garden. *Scadoxus natalensis* may be grown in the garden in the summer, and as soon as the foliage begins to flag should be dug and potted-up to flower a month or so later in the house, where it should remain through the winter. New growth will begin and with the arrival of spring it may again be potted out. This is a very colorful species. Not only are the flower stems heavily spotted red, but leaf scales at the top of the bulb are also. It superficially resembles *S. katherinae* in form and size. The inflorescence is composed of densely packed flowers in a four-each umbel.

In my collection are three horticulturally distinct forms of **Haemanthus albigiflos**, plus transitional forms. The most common form of **H. albigiflos** in California is an easy-to-grow, shade- and moisture-loving plant. Soil, so long as it is well-drained, seems to be unimportant as they thrive in my garden in a sandy mix, one with humus, and equally well in plain garden soil. The plant is something of a chameleon in that it appears to be a totally different plant under coastal conditions from those grown in interior valleys. I had given some bulbs of this type to friends in Laguna Beach. Several years later while, inspecting their garden, I noticed a handsome **Haemanthus** with foliage twice as wide as mine, and I expressed a desire to have one. I was informed that the bulbs had come from my garden. An argument ensued because I was positive the two representatives could not be the same. The leaves of the beach example were not only twice as broad, but a deeper green and were rigidly held half erect. The foliage and bulbs in my garden were only three inches wide in contrast to six for the others, but they were elongated and limp-looking. Actually, they are not limp, but brittle and can snap if pressed. They are this way in four different exposures and at my neighbors also. I do have another variety of white **Haemanthus** with wider leaves which has maintained this broad foliage for many years, though not as broad as when first obtained from a coastal source. Under inland valley conditions **Haemanthus albigiflos** has leaves 3 inches wide, 18 inches long, and is conspicuously hirsute. The flower heads, immaculately white, golden-tipped with pollen, are held on 15-inch stems. The globular head is about one and one-half inches wide and about the same in length. They are oddly attractive. The combination of white flower and conspicuous golden pollen and rich green foliage is sprightly and clean looking. It is evergreen and should not be dried out completely. If well placed (protected from the sun and with constant moisture) they will grace the spot for years. Some of mine have been in place 25 years and form pleasant mounds of foliage and flowers. They multiply well, but not excessively.

Another white-flowered **Haemanthus** is my favorite of the white. The leaves were broader when I first acquired it and they appear broader than the type because they are much shorter, being about 5 inches long. It is pert-looking with its foliage held semi-erect. The flower stem is not nearly as long and it remains erect even when carrying the seed capsules. These are a soft orange and not unattractive, but far from conspicuous. There are several dozen individual flowers framed by six large green bracts, like tiny paper doilies. Each capsule usually contains two or three seeds, but occasionally four or only one. Though the flower is immaculately white, the seeds have a good deal of color and appear to be salmon. I have never seen a varietal name attached to this form. It is choice and too rarely encountered.

Another form is much smaller and might even be described as cute. It fits the description by John Weathers in his *Bulb Book* for **Haemanthus albigiflos** var. **burchellii**. It is much like **H. albigiflos** except for its diminutive size.

Haemanthus albigiflos has been crossed with **H. coccineus** and is named **H. clarkei** in honor of Col. Trevor Clarke who hybridized them at Kew at the turn of the century. L. S. Hannibal repeated the cross [*Herbertia* 15:76-78 (1948)] and reports that though his plants are fertile, they do not produce offsets. Some 20 or so years ago I made the same cross and, though the resultant plants were not cross-fertile, they multiplied generously and could, for the most part, stand up to summer watering. Some of the choice ones were lost, doubtless due to their culture, but many survived. In any event, the color of the inflorescence came in a wide variety of shades of peach, apricot, and terra cotta. Like Mr. Hannibal's, they are briefly deciduous.

Haemanthus coccineus is the species that gave the genus the epithet of "Blood Lily", which, in some cases is inappropriate because some are pale, salmon, flesh, or even white. It is still uncommonly encountered, though it has been in California for over 60 years. This is probably due to the difficulty of proper placement. It requires dry conditions in summer and its long foliage is brittle and easily damaged unless in a protected place. For decades it was offered by Giridlian and Houdyshel. At present, the only sources appear to be Guy Wrinkle and Alan Greenberg of Cycadia.

The foliage consists of a single pair of succulent leaves, six to eight inches wide and two and one-half to three feet long, which lie flat on the ground. It is the largest of the showy brush types and is winter growing, when it enjoys a generous amount of watering. It should be situated with an eye to maintaining the immediate area absolutely dry during the dormant period. Drainage should be sharp. Summer watering is not necessarily a death sentence, but the area should be kept as dry as possible and frequent wetness is definitely to be avoided. Moisture, combined with warm temperatures, induces rot. The top of the bulb should be planted even with or slightly below the surface of the soil. In a pot, the bulb may be placed so that most of it is above soil level, thus allowing more room for root development. One can begin prudent watering in late summer or early fall, or he can wait until the flower bud first emerges in September. The scape rapidly extends from six to nine inches and is generously mottled and banded with a rust red. The flower head is about two inches across and is principally made up of colorful filaments of scores of otherwise inconspicuous flowers tightly compressed within six large flower bracts. These are bright red, very conspicuous, and make for the red appearance of the inflorescence. Actually, the filaments of the flowers are a coral color. The generous amount of pollen on the filaments creates a red and gold combination that is striking. Snjman observes that **H. coccineus** is the most widespread geographically and the most variable of **Haemanthus**.

Several **Scadoxus** have long been grown in California as **Haemanthus** and horticulturists have been thrown into confusion because of botanists lumping several horticulturally distinct forms into synonymy. What were once known as **Haemanthus puniceus**, **H. magnificus**, and **H. natalensis**, we are told by Friis and Nordal, are now **Scadoxus puniceus**. I suspect we shall have to remain botanically incorrect in order to distinguish among these forms. What has for long passed as **H. puniceus** is easy to grow in California. It is evergreen. **Haemanthus magnificus** is winter dormant. True, **H. natalensis** is much like the latter, but each is easily twice the size of **H. puniceus**, both in foliage and in inflorescence.

At any rate, **Haemanthus puniceus**, pre-Friis and Nordal, is unique among **Haemanthus/Scadoxus** in that though it appears to be stalked, the leaf stems actually arise from the bulb or, if the bulb is covered, from ground level.

The leaf stem is heavily peppered with reddish spots and is about eight inches long; the wavy leaf blade is a bit longer, about ten inches. The flowers or filaments are salmon and rather pale. The four surrounding bracts are green and do not enhance the beauty of the flower. The crowning beauty of the inflorescence is the four to six cranberry-sized seed capsules' form and color. These are scarlet colored and are decorative for months and this is the primary reason for their cultivation. I have found it easier to maintain in pot culture even though the pot sits on the ground. It offsets fairly well, but the seeds are so large they are worth propagating.

Scadoxus puniceus, of the robust growth and huge flower head that formerly were designated **Haemanthus magnificus** and **H. natalensis**, is winter dormant, and for my area it is best grown in pots, watered sparingly in winter, and moved to warm quarters where it may remain evergreen. These are certainly among the most beautiful of the showy, brush types, most of which are odd, handsome, or unusual, but not usually beautiful. The flower head of **S. puniceus** proper is dowdy, that of **S. magnificus** is conspicuous, startling, and beautiful. The scape is heavily dotted with red and is about 18 inches tall. The stalked foliage rises to two feet. It is deciduous unless kept warm in winter.

The most magnificent of the **Haemanthus/Scadoxus** alliance is what was formerly **Haemanthus katherinae** and is now **Scadoxus multiflorus** ssp. **katherinae**. For Californians, there are horticultural distinctions of great importance. **Scadoxus multiflorus**, from tropical Africa, loves warm nights and thrives under Florida conditions. It makes a satisfactory house or glasshouse plant.

On the other hand, **Scadoxus katherinae**, from South Africa, does not like warm nights and thrives here, in California. It, too, may be grown as a pot plant in a five-gallon container or redwood tub. **Scadoxus multiflorus** does not require such commodious accommodations because it is not as robust a grower. It should be dried off during winter to avoid the cold and wet.

Every year some, but not all, of my **S. katherinae** go dormant. What accounts for this is hard to say. It is sometimes apparent before cold weather has set in. They get moisture from winter rains but the soil is well drained. They are grown in a long corridor formed by a seven-foot wall to the north and the house/garage to the south and are covered with translucent fiberglass. They are protected from direct sunshine, the humidity is increased somewhat and, more importantly, protection from wind is provided.

Under these conditions stalks develop holding six to eight broad, medium-green leaves over two feet above the soil. The flower umbels are held on stems well above the foliage and are about 36 inches long. It is a conspicuously imposing plant that is striking in the manner in which the foliage is held, as well as the sensational inflorescence it produces. Some peduncles are liberally speckled with reddish spots, but others are entirely green. There seems to be no significance to this as to robustness or the quality of the flower or intensity of color.

Foliage is often held in good condition through the winter. Though, naturally, not at their best, neither are they bedraggled except for those in the process of yellowing in preparation for dormancy. I never remove growth as long as it carries any green. Mrs. Eliovson recommends they be kept dry in winter, but mine are never allowed to dry out.

With the arrival of warm weather in spring, some plants will still hold a good head of foliage. At ground level a new growth, like a little green pyramid, will break through the old stem. As the new growth enlarges, the old one topples over but still remains green for weeks. It gradually loses all green and becomes limp and yellow, but retains considerable moisture. The shoot develops rather rapidly into a sturdy stalk holding aloft a handsome crown of new foliage.

In late spring a bud clasped within two large green bracts quickly develops. The inflorescence, five or six inches across, consisting of numerous individual star-shaped flowers, begins to open forming an interlocking network of petals forming a sphere. The color is an off-red, an orange-red, a lovely coral or salmon, the intensity varying among the different bulbs.

These can be quickly increased from seeds. The pollen filaments project from the flowers and pollination is easily effected by cupping the hand and gently rotating it over the pollen which is transferred to the stigmas. A generous crop of seed will result, probably 80 percent set. These will not ripen until late fall. The seed capsules are quite fleshy. They are bright scarlet and very ornamental.

Upon removal, the seed appears quite clear so one can detect the green embryo within. The seed capsule usually contains a single seed, but occasionally two, and infrequently three. Seed is most easily accommodated in a container. They should, like *Clivia* seed, not be covered, but rather placed on the surface and gently pressed-in about half way. A cover of a pane of glass will help keep the surface moist, but it must be ventilated or mold and mildew will develop. A radicle will emerge long before the first leaf appears and care must be taken in inspecting their growth. Sometimes a radicle grows upward and the seed has to be picked out and pointed so the radicle will go into the soil. If one has many seeds, some may be planted *in situ*, but a snail or slug can decimate these in a single night. The best way to protect seedlings is to elevate them on a plant stand or in a hanging basket.

The first year only a single leaf will emerge and if this is eaten or damaged it really retards development. The second year, two new leaves will appear and the first year's leaf will continue to remain green for many months. The third year things begin to speed up and the bulb has some size. It is at this stage that mine are usually planted outside.

Snails and mealy bugs are the worst pests and do serious damage. A seedling can be eliminated and a mature bulb have its foliage left in ribbons by snails. Mealy bugs weaken the plant by attacking the leaves where they join the trunk. The tissue dies and the leaf collapses and the bulb is reduced in size because the leaves do not produce food for the bulb to store. Mealy bugs are often most bothersome when the bulbs get too much shade. Growth is weak and invites invasion by these pests. *Scadoxus katherinae* wants shade but good, strong light.

The most eminently desirable type of *Scadoxus katherinae* is a form simply called 'Hummel Hybrid'. It may indeed be a hybrid, but it is more likely a seed-selected form having much richer coloring on a very robust plant. One encounters it from time to time in local nurseries in the San Diego area, principally, but it can be obtained from the Louisiana Nursery, Rt. 7, Box 43, Opelousas, Louisiana 70570.

An *Haemanthus sanguineus* recently acquired from Guy Wrinkle looks promising. The plant itself is relatively large with handsome foliage. It has yet to flower, but this species is, as a rule, very colorful.

Snjman mentions only *H. clarkei* as being a hybrid. I have recently acquired a "Japanese hybrid" of the *H. albiflos* type. It is likely a cross within the same species.

The largest *Haemanthus* I have ever seen is 'Coco Lobo Pink', an Edward C. Hummel hybrid. This is rare and has a \$50 price tag. Its sole source, so far as I know, is William Baker of Reseda, California. Both the bulb and its foliage are huge and, as with most *Haemanthus*, the inflorescence is ridiculously small in proportion to the bulb. It is an undistinguished white color. One parent was likely *S. coccinea*; the other must have been an unusually robust white variety.

In *Scadoxus*, hybrids are reported to have been made between *S. katherinae* and *S. magnificus* (then known as *H. magnificus*).

Scadoxus 'König Albert' or 'King Albert' is of the **H. katherinae** type, but the plant is more stocky. It may be a hybrid. It can be grown out-of-doors in Southern California in a sheltered area. There is a large planting of it, under lath, in Escondido for the cut flower market. This is the only **Scadoxus** whose flower is used commercially, that I know of locally.



Scadoxus multiflorus ssp. *multiflorus*.

ALIEN BULBS IN WESTERN AUSTRALIA

L.J. LARSSON

PALMYRA, WESTERN AUSTRALIA, AUSTRALIA

ALL plants have a purpose and their own particular beauty; however, there will be folk who disagree, calling the following bulbs, corms and rhizomes "weeds," and in some cases, "noxious weeds." Sad to say, "a weed is an undesired, uncultivated plant that grows in profusion so as to crowd out a desired crop."

I have always lived in the southwest corner of Australia, which has a Mediterranean climate. It is there that *Zantedeschia aethiopica* (Arum-Lily) grows in profusion, taking up good farm land. There was a small township call "Arumvale," long since gone. Now even the lilies have been eradicated and the land is a private farm. I can remember seeing a flower with a green tip on the spathe amidst the clump of white flowers—these plants are now widely grown as 'Green Goddess.'

Also in our area *Watsonias* grow along the roadside and railway lines—*Watsonia aletroides*, *W. meriana*, but mostly, large areas of *W. pyramidata* in shades of pink, white, and apricot.

Where there are deserted timber mills and farms, *Amaryllis belladonna* (Cape Belladonna), *Narcissus jonquilla*, *Ixia maculata*, *I. paniculata*, *Sparaxis tricolor*, *S. grandiflora*, *Allium neopolitanum*, *A. triquetra*, *A. cepa* and *Chasmanthe floribunda* (Flags) are found. As a boy, Joe, my husband, had "sword fights" with his brothers using *Allium cepa* scapes with seed heads attached.

My friends tell me they have seen *Babiana stricta* growing in several areas; I have only seen them in the Boyanup district. *Tritonia crocata*, *T. lineata* and *Freesia refracta* are roadside plants. *Freesia* abounds at Bunbury, where we had our market garden in the early days of my marriage to Joe. There was a large patch of *Freesia refracta* in the sand dune on the corner of our six acres. Mushroom season, after the early winter rains, heralded the appearance of *Oxalis glabra*, *O. hirta*, *O. polyphylla* and *O. purpurea*. I have always delighted in these little flowers; no doubt the farmers wouldn't agree.

My garden in Bunbury was thick with *Romulea rosea* and *Oxalis cernua* (sour sob, yellow sorrel). Actually these are wide-spread throughout the state; they are even here in my metropolitan garden, together with two other very unwelcome "weeds," *Allium vineale* and *Oxalis bowiei*.

I still find alien bulbs in our area south of the Swan River, such as *Homeria miniata*, *Trachyandra divaricata*, *Lachenalia reflexa*, the blue *Ferraria autherosa*, and brown *Ferraria crispa*. Also *Gladiolus caryophyllaceus* is fast spreading through the metropolitan area.

At Christmas, during our warm summer season, we motored to Albany on the south coast and saw *Gladiolus undulatus* growing in patches of over 30 miles. We stopped to inspect them and Joe wouldn't allow me to plant any after seeing all the cormlets attached. I have grown several species listed above and had to be careful; given half a chance *Tritonia* and *Lachenalia* would escape.

Amaryllis belladonna, the common Cape Belladonna, can bloom from December onwards if we have summer rains to trigger their growth; however, the leaves don't grow strongly until closer to the Easter period. The hybrids I have read about in **Plant Life** are not available in Perth because no one is interested in those "common old things." In older gardens 'Hathor' can be found; a bulb slightly more prestigious than the typical form.

Most of the naturalized plants in southwestern Australia have been brought from South Africa during the early days of the colony, either by folk admiring the new plants at the Cape and gathering them to start gardens in the new land, or species were introduced in the sand ballast of sailing ships.

Some 7,726 species of plants grow in Western Australia, of which 763 are naturalized imports. At least 297 species are awaiting description; many more doubtless remain undiscovered.

My thanks to Mr. T. Aplin at the Western Australia Herbarium for helping with the nomenclature of our alien bulbs. It has been a happy time reminiscing or identifying flowers in my books. Best of all, I have the realization of belonging to the World Bulb Fraternity. My husband, Joe, has shared these memories and seen most of these plants.

These comments are based on sightings over a period of 50 years, covering roughly 10,000 square miles. There are many more in Dr. J.W. Green's *Census of the Vascular Plants of Western Australia*. My contact with these plants has been in my garden.

AUSTRALIAN AMARYLLID REPORT

WARREN J. GLOVER
EARLWOOD, NEW SOUTH WALES, AUSTRALIA

VIRUS

VIRUS infection is a constant threat to prized plants. Most of us will have experienced the chagrin of discovering a valued plant with the dreaded mosaic mottling on one or more leaves. It is commonly accepted that there is presently no cure for this condition other than the uncertainty of tissue-culture.

I became aware of the perniciousness of viruses when our quarantine department phoned one day to tell me that the mottled leaves sent to them had created a minor scientific precedent. I was the first person in Australia to have an identified Potyvirus Group Y in a *Hippeastrum*. Doubtless thousands of other *Hippeastrums* throughout this country were similarly infected, but no one had taken the trouble to ask about the mosaic mottling, let alone have it identified.

Recent developments, mainly in the USA, but also in the UK and Australia, however, point to a possible solution to this problem. Nearly all of the reading I have pursued on plant biology has come from the *Scientific American*, but some tantalizingly brief summaries have appeared in the English weekly *New Scientist*.

A superficial analogy has been made between plant sap and animal blood. Could we infer from this that, seeing that plants have a vascular system of a sort, we could inoculate a plant with some type of anti-body to combat a virus? While to make such an analogy is stretching a point, we do share some similarities. Tomato plants in Great Britain are inoculated with an attenuated strain of Tobacco Mosaic Virus (TMV). This causes a chemical reaction with the plant, not unlike the animal's production of antibodies, that increases the tomato's resistance to virulent TMV.

In addition to this method being used on European tomato crops, it is employed to control passion-fruit woodiness Potyvirus in Queensland passion-fruit, to control Citrus Tristeza Closterovirus of grapefruit in Australia, and other citrus fruits in Brazil.

At a symposium organised by the Australian Institute of Agricultural Science, Dr. Adrian Gibbs of the Research School of Biological Sciences, Australian National University, reported on experiments using the Ti plasmid of *Agrobacterium tumefaciens*. In Gibbs' own words:

My colleagues and I are starting to investigate the possibility of isolating and transferring of 'cross-protective genes' as a way of conferring specific resistance to particular viruses, free from the potential problems that come from the use of avirulent virus variants.

This latter term includes attenuated virus strains which are avirulent (in a way, not virulent or of low potency). *Agrobacterium tumefaciens* is a common soil bacterium. It can invade an injured plant at the wound site and cause crown galls which are uncontrolled tumorous cell growths. These galls continue to grow even after *A. tumefaciens* has been eliminated from the plant. Quite simply the bacterium's DNA becomes incor-

porated into the nuclear DNA of the plant and the new gall cells are self-replicating because the transferred DNA (T-DNA) is now an integral part of the plant's genome. British scientists originally worked to induce the plant to produce nutrients called "Opines" (derivatives of amino acids). Once induced, the plant continues to produce these even after the bacterium has been eliminated.

The remarkable ability of bacterial DNA to combine with plant DNA is unique to the **Agrobacterium** group and although the method by which this is accomplished is not fully understood, the ability of the bacterial DNA to recombine with the plant's DNA is exploitable in the genetic manipulation of plant cells. If new DNA is inserted within the chain of T-DNA then the altered T-DNA can be used as a vector for carrying desirable genes into any plants or to carry the DNA of an attenuated virus to induce a specific resistance.

Raymond Dwek and Tom Rademacher of the Department of Biochemistry at Oxford University are reported to have developed a sophisticated method for establishing the sequence of sugars that comprise an oligosaccharide molecule. They say that these sequences help molecules to identify each other as the cell membrane glycoproteins are oriented so that the oligosaccharide chains protrude from the outer surface of the membrane and they hope to break the code of sequences. The binding of bacteria and viruses to host cells is one of the many interactions in natural systems that appear to be mediated by these molecules. In his answer to my enquiry, Raymond Dwek states:

It may be that our discoveries will have made a major breakthrough concerning virus infection of plants, but at present, we are simply exploring the nature of oligosaccharides in a variety of systems (some plants) but mainly in molecules and cells involved in the immune response. Perhaps in a year or two we may be able to address the problems that you are interested in.

Professor Leo Paquette and a team of structural chemists at Ohio State University report that they can build a molecular dodecahedron. One important result of this research was the discovery that a highly symmetrical molecule such as the dodecahedron with an amino group attached to one vortex readily passes through the membrane of a cell and tends to destroy virus particles inside it. Professor Paquette in correspondence, indicates that DDH-NH₂ may prove highly effective against viruses, but that synthesis of meaningful quantities of this substance may be a problem. He appears, however, to be optimistic.

Gerald M. Rubin and Alan C. Spradling of the Carnegie Institution, Washington, D.C., USA, working with **Drosophila** (fruit fly) P element transposons, inserted the P element into a plasmid and injected the plasmid into a **Drosophila** embryo to effect an eye-color change that is heritable. They predict that such integration into chromosomal DNA will produce plants immune to disease. No answer was received to my enquiry concerning the use of this technique to develop virus-free plants.

One of the best introductions to understanding the processes and uses of manipulating DNA sequences has been written with far more eloquence than I am capable of by Michael Rose and Ford Doolittle. Their article *Parasitic DNA - The Origin of Species and Sex*, in **New Scientist** 16 June 1983, Vol. 98, No. 1362, is recommended to all interested in this subject.

Lawrence E. Garner, in reporting on the effect that acetylsalicylic acid has on virus (APLS autumn, 1984 Newsletter), specifically tobacco mosaic virus, deserves a vote of thanks for bringing this to our attention. Thanks, too, to our Editor for spotting and reprinting this report.

CRINUM ASIATICUM CULTIVATION IN NORTHEAST GEORGIA

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ATHENS, GEORGIA, USA

SINCE 1972 I have grown *Crinum asiaticum* Linn. in St. Augustine Beach, Florida. There is nothing remarkable about this. But in July 1985, I transplanted two medium-sized clumps from St. Augustine Beach to Athens, Georgia. Athens is located in the northeast Piedmont Plateau region of the state. The approximate latitude, longitude and elevation respectively are 33° 57' N, 83° 19' W, 800 feet. In terms of the Arnold Arboretum hardiness zones, Athens would correspond to the uppermost part of Zone 8. Both clumps surviving the 1985-86 winter sent up many scapes and set viable seeds during the following summer and fall. This is noteworthy given that *Crinum asiaticum* has usually been considered a suitable landscape plant in lower Zone 8, Zone 9, and Zone 10. Indeed, L. S. Hannibal (1970-71) in "Garden Crinums" has *Crinum asiaticum* fifteenth on his list of *Crinum* species in their order of tolerance to winter weather. Hannibal indicates hardiness to southern California and central Mississippi.

One clump was planted at the base of a brick wall that receives a southern exposure. This clump receives about one half day of full sun and high shifting shade during the rest of the day. The clump had two vigorous heads and one small offset at the base when planted. The two large heads were not separated but were planted 8 to 10 inches deeper than they had been growing in St. Augustine Beach. This put their crown at ground level. The smaller offset was barely pencil thick. This small offset was separated and planted near the parent plant at approximately the same depth as it had been growing in St. Augustine Beach. The soil in Athens is a heavy clay. When planting the crinums, copious amounts of peat and perlite were added to the three feet wide by three feet deep holes that were necessary to accommodate such large bulbs. This clump would be protected during the winter by a three inch mulch of pine straw and by the proximity to a brick wall that would be warmed by the sun during the day and radiate heat during the night. The second clump was planted in an exposed location and would not be protected during the winter by either mulch or a nearby brick wall. This second clump was somewhat smaller than the first. The only fertilizers given were generous portions of bonemeal at planting and a small amount of muriate of potash in the spring.

Both clumps survived the 1985-86 winter and by the end of summer 1986 were as large or larger than when planted in summer 1985. The more protected clump fared somewhat better than the more exposed clump. The more protected clump remained two-headed with one small offset. The offset survived the winter and had increased in size. The two large heads produced leaves approximately 3 1/2 to 4 feet long. This clump threw three scapes in July, one in October (Figure 1), and attempted to throw another in November, but it was caught by a hard frost. One scape was allowed to fully mature four large seeds (Figure 2). These seeds were fertile and they later germinated. The scapes measured about 30 inches in length. One notable difference between the blossoms in



Figure 1. Scape of *Crinum asiaticum* against protective brick wall. Photo by author.



Figure 2. Fleshy seed of *C. asiaticum*. Photo by author.

Athens relative to St. Augustine Beach is the number of flowers per umbel. In Athens the number is only 12-20, whereas in St. Augustine Beach it is common to find 25 or more flowers per umbel. This may be due to the bulbs having been recently transplanted. The less protected clump emerged in the spring as a three-headed clump. The leaves on this clump grew to 2 1/2 to 3 feet in length. This three-headed clump threw four scapes in late June throughout July, but never reached the size of the more protected clump nor did it throw any scapes in the fall. This may have been due to its greater exposure or to its having undergone division from two heads to three heads.

It is still too soon to conclude whether *Crinum asiaticum* is permanently winter hardy in the upper limits of Zone 8. A good indicator of persistence is that the recorded temperatures for both December 1985 and January 1986 averaged to be below normal. In December 1985 there were 21 days with minimum temperature readings below freezing, the lowest being 11° F. In January 1986, there were 17 days with minimum temperatures below freezing, the lowest being 7° F. The lowest temperature ever recorded in Athens was -4° F. With this in mind, I will update this report in several years. Regardless of whether *Crinum asiaticum* persists in this region or not, it is exciting to see such rich tropical foliage and large exotic blossoms in this part of Georgia.

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SLEUTHING SOME MYTHICAL *HYMENOCALLIS* OF MEXICO

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LIKE many genera in the *Amaryllidaceae*, the genus *Hymenocallis* has several species that are involved in controversies over identification and nomenclature. This report relates to one of those controversies.

SPLIT STAMINAL CUPS

In the summer of 1972 I travelled to the Mexican states of Sonora and Sinaloa, hoping to settle a minor controversy over the identity of an *Hymenocallis* species. This involved visiting the type locality of *H. sonorensis* reported by Paul Standley (1937). I intended to collect live material and herbarium specimens for study and cultivation. This field work indicated that *H. sinaloaensis* Traub (1967) was the same plant as *H. sonorensis*; thus, the former is proposed for synonymy. The genus *Hymenocallis* is one of the more difficult of the *Amaryllidaceae* to work without studying living material along with dried specimens. An eminent botanist recently confided in me that *Hymenocallis* is the last genus of the *Amaryllidaceae* in which he would publish a new species without recourse to live material. Thus, it is often necessary to return to original collection locales to bring back live material. This kind of "detective work" is expensive and time consuming, but it is the only way to ultimately correct some problems.

HYMENOCALLIS PARTITA

A. Worsley (1899) and J. D. Hooker (1901) published what was purported to be a most unusual *Hymenocallis* species with staminal cups split nearly to the base. It was named *H. schizostephana* for schizo (split) stephana (crown); at the time the name seemed appropriate. Little is known about this plant. It was briefly cultivated at Kew and believed to be of Brazilian origin. Whether it ever flowered at Kew is never mentioned, but it was considered to be a member of the "speciosa alliance" (Traub, 1962) because of its broad foliage with petioled bases. Sealey (1954) mentioned that it was known only from the original introduction, and the dried specimen was easily recognized by the unusual staminal cup. The cup was described as "vase shaped, about 1.5cm high, more or less deeply split between the filaments, which thus appears to be deeply winged at the base."

Ravenna (1985) described another such *Hymenocallis* species from the state of Chiapas, Mexico, in the vicinity of Ocosingo—naming it *H. partita*. The original specimens were collected in the late summer of 1954 by R. L. Dressler and deposited in the New York Botanical Garden Herbarium (NY) under Dressler's #1583. Like Sealey, Ravenna appears to have made his determination from dried specimens, rather than "live" flowering material taken by himself from the wild. Ravenna observed that *H. partita* was "a remarkable species readily distinguished by the staminal cup parted to the base in six winged portions."

HYMENOCALLIS PORTAMONETENSIS

Concurrently, Ravenna (1985) described another species from Chiapas as *H. portamonetensis* from a specimen made earlier in this century by C. A. Purpus #12092 (F type): "Mexico, Chiapas, pine forest, near Rio Puerto Moneda." Ravenna indicated (personal correspondence) that he had not seen live material of this plant, and did not know the location, Rio Puerto Moneda. He was hoping that I could find both plants in my travels in Chiapas. Ravenna commented in his description that "*H. portamonetensis* could be mistaken for *H. guatemalensis* Traub, which, however, has thin-textured leaves with transverse veinlets."

VARIABLE RAIN DAMAGE

June and July's weather in San Antonio, Texas brought higher-than-average precipitation. This hampered hybridization efforts and specimen-making of *Hymenocallis* from my garden. I was trying to do intensive work with *H. galvestonensis* flowering in early July; each day when I thought scapes were prime for cutting and pressing, heavy morning or afternoon showers would wreck the delicate staminal cups by splitting them to the base. Time was running out and I was having trouble obtaining a perfect umbel without some damaged flowers. It was then I recalled reading Ravenna's latest work—I began to have doubts about those "split," "schizoid" and "winged" staminal cups. Were *H. schizostephana* and *H. partita* valid species, or were they simply rain-damaged specimens? I went into my garden where five *Hymenocallis* species were flowering: *H. arenicola*, *H. riparia*, *H. howardii*, *H. galvestonensis*, and *H. sp.* 'Tropical Giant'. Upon examination, I found all had suffered rain-damage to the fragile, membranous staminal cups. Many were uniformly split to the base (creating that "winged" effect mentioned above). I recalled seeing this often on various collecting trips in Mexico during the rainy season, but had paid it little attention. In 1983 I found a large colony of *H. baumlilii* flowering in Veracruz and stopped to dig bulbs. I examined a great many clumps before finding a few undamaged flowers worthy of photographing. A picture of such a clump appears in Howard (1984). One clump in the center is undamaged, while the portion shown at the extreme right has many flowers with cups damaged and split to the base (Figure 1). This difference may be due to the timing of the showers and the variable opening of the flowers in late afternoon. Generally, *Hymenocallis* flowers will open within thirty minutes of one another in any given colony. Opening time is on a clump-basis; an entire clump might suddenly have flowers spring open within minutes of one another, while another clump may open fifteen or even thirty minutes either way. These observations must be seen in the field—or in cultivation—this kind of information one will not learn from studying a dried specimen.

FIELD OBSERVATIONS

Although the observation of rain-damaged cups in my garden was intriguing, I wanted to test it in the field at the type collection site of *H. partita*. My summer of 1985 included an annual plant exploration foray in Mexico. The trip was planned to incorporate a good deal of southern Mexico (Oaxaca and Chiapas) in the itinerary. A few weeks later in Chiapas, I put Ravenna's location notes to work. I had managed to obtain good maps before leaving home, and found several more after arriving in Chiapas. Prior to leaving San Antonio, I had taken Ravenna's description and keyed it to *H. acutifolia*,



Figure 1. Rain-damaged flowers of *H. baumblii*. Photo by author.



Figure 2. Rain-damaged flowers of *H. acutifolia*. Photo by author.

H. riparia, or **H. littoralis**. Although these are closely related and easily confused, they are distinguished from all other **Hymenocallis** by tepals which are adnate (joined at the base) to the staminal cups. This group is highly tolerant of aquatic conditions and is often found growing in streams. Foliage is deep green, and sword shaped. They differ from one another in their flowering times, and geographically are thought to be segregated as separate species.

Once in Chiapas, I drove toward Ocosingo; as I neared the vicinity, I spotted **Hymenocallis** flowering alongside a stream. It was **H. acutifolia** with the staminal cups split to the base. Foliage was a meter long, as Ravenna had described, and concurred in shape and width. I drove into Ocosingo (about 10-12 miles) looking for more colonies, but saw none. I learned that the Dressler type locality (Laguna Ocotol Grande) was on a "finca" (ranch) nearby that could be reached only by horseback. I had no time for that, but did note the large valley was crossed by the same creek containing the colonies of **H. acutifolia**. The terrain and climatic conditions seemed similar for many square miles in any direction. In other words, I had an excellent cross section for the habitat of Dressler's specimen. I also had a good case for placing **H. partita** into synonymy, it being a rain-damaged specimen of **H. acutifolia**.

STOLONIFEROUS PLANTS

I then returned to the stream to study this group for which I had invested so many miles, dollars, and time. It seemed I could now put the true identity of **H. partita** behind us, but these plants were still interesting. In digging, I noted some individuals clearly formed basally-attached offsets at the bulb-bases; others were clearly stoloniferous, with bulbs forming at the end of long white stolons up to and beyond ten inches from the mother bulb. Aside from that variation, they were identical. I had often heard that certain **Hymenocallis** were reported to form stolons AND basal offsets, but this was my first time to observe this phenomenon. I found no evidence of plants doing both simultaneously. Nonetheless, I dug both forms for study back home. As with the rain-damaged cups, I felt the methods used in this vegetative propagation were of academic interest, but had nothing to do with defining this species.

Time had flown and it was getting into late afternoon. Investigating the colony, I found the **Hymenocallis** flowers were ready to open; I examined maturing buds, forcing them open to check the undamaged cups. With no strong rain to pelt them, the cups were quite normal in form. A month later, back home in San Antonio, one of my potted bulbs of this group had the misfortune of being hit by a late sudden summer shower—the cups split to the base.

PUERTO MONEDA LOCALITY

My investigation of Ravenna's other species, **H. portamonetensis**, was not so simple. The collection location notes said "pine forest." That made it tough, since it implied a high elevation. The state of Chiapas is roughly the size of Ohio. Not tiny, but not huge either. I had spent hours examining Chiapas maps but could not find a hint of "Rio Puerto Moneda," be it creek, stream, river, or village. Local maps yielded the same results. Often I was firmly told there was no such location in Chiapas; the ONLY place with a similar name was Puerto Madero. I had been there once before; years ago. It is on the Pacific Coast, not far from Tapachula and just north of the Guatemalan border. The

correlation was beginning to make sense: the pine forest, the name, the location on the coast near Guatemala. The ONLY current "Puerto" on the Chiapas coast is Puerto Madero, named for the Mexican president and revolutionary hero. The explorations of *Purpus* predate President Madero. As for the pine forests, they do indeed grow near the Pacific Ocean in Chiapas—at much lower elevations than one normally expects. The "Rio" part was merely a creek, a common exaggeration, not only in Mexico but Texas as well.

Ravenna noted his specimen of *H. portamonetensis* had fairly broad foliage, comparing it to *H. guatemalensis* Traub. Both share this trait with *H. tenuiflora*, a species I collected near Esquintla, Guatemala in 1973. It is easy to spot by its low, broad leaves, and it grows a few miles inland from the ocean at that point. As the crow flies, Esquintla is quite near Puerto Madero—about fifty coastal miles.

HYMENOCALLIS TENUIFLORA

Upon returning home, I compared my collected plants of *H. tenuiflora* with Ravenna's description, and found them quite similar. The Puerto Madero collection *Purpus* found years ago is likely a northerly extension into Mexico's borders of a plant long recognized as a valid species from Guatemala and other Central American countries.

Traub (1967) based his *H. guatemalensis* on cup lengths of 2.5cm long, but this is not always true, as my own 1973 collections verified. I've observed that cup lengths for this species can vary from just under 2cm to as much as 3cm. By the same token, populations of *H. tenuiflora* can have as few as two ovules per cell in the ovary. Depending on the individual species, such numeric variances are not unusual in *Hymenocallis*. My own collected plants agree with William Herbert's statements that the foliage is fairly broad in the middle while noticeably narrowing toward the base and outwardly spreading. Flowers are indeed on the slender side (*tenuiflora*) but this single character can be misleading. The cups are slightly funnellform (instead of rotate) and the segments ordinarily reflex downward from the cup. I have one specimen with segments inclined to spread rather than dangle downward, so even that character is capable of some variation. For these reasons, I see no logic in maintaining *H. portamonetensis* as anything more than a synonym of *H. tenuiflora*.

In 1973 I drove to Lake Amatitlan, Guatemala, but was unable to locate any *Hymenocallis* near the road that skirted the lake. I do note that Traub gave an April flowering date for the specimen he named *H. guatemalensis*; this is much earlier than other Mexican and Guatemalan *Hymenocallis* which are geared to flower when the rainy season arrives in the summer. Perhaps this was only an aberration? This controversy cannot be settled until specimens of *H. tenuiflora* can be compared with both Traub's specimens of *H. guatemalensis* and Ravenna's *H. portamonetensis*.

LITTORALIS ALLIANCE

The members of *Hymenocallis* with tepal bases adnate to cup bases should not be confused with any other species. This is a subtle character but most useful. These compose a "littoralis alliance" and are a dominant group in central and southern Mexico; they are often found in fast-moving streams which cascade from higher elevations and empty into Gulf and Pacific estuaries. Their freshly ripened seeds do not float, but sink like lead weights to the bottom of the streams, assuring that they are not widely dispersed

by water movements. One never discovers them on sandy Mexican beaches as one might expect to find their close relative, *H. littoralis*, in Central America. This is an important detail that William Herbert did not fail to notice and comment on. Indeed, Herbert had doubts about the identity and validity of *H. littoralis*. He could not conceive of this Mexican streamside plant of mid-elevations frequenting tropical, hot sandy beaches. I concur with Herbert on this point. When I find *Hymenocallis* species on such beaches, I find *H. latifolia*, which does not have an adnate cup. This is a much larger plant with more robust habits. *H. maximilianii* is found only in the inland state of Guerrero, and does not seek the sandy coasts, but rather more inland meadows and streams (Howard, 1982). In that manner, it is akin to *H. tenuiflora*. Of the coastal group, *H. baumlii* (Ravenna, 1979) is found in Veracruz, Oaxaca, and Chiapas; most often in pastures, roadside ditches, and rolling hilly country on lower slopes.

CAVEAT

In summary, the genus *Hymenocallis* is not a group for the "splitters and lumpers" of taxonomy. These plants need to be collected in their native lands and studied as living material. Subtle differences in fragrances, pollen colors, leaf colors, seed characters (surface and shape, float or sink in water, color, size) can be very important in delimiting a species. Such characters are rarely present in dried material. The same applies to whether or not the floral tubes are straight, curved, or only slightly curved. Some seeds are polyembryonic. This can only be observed on germination. Fragrances vary in some species from sweet, to unpleasant, while some species lack perceptible odor. *H. acutifolia* is noteworthy in having flowers that strongly suggest vanilla. Indeed, we put some vanilla extract on finger tips and then sniffed flowers, then fingers. A blindfolded man could not tell the difference! The thorough botanist must be willing to check into the multitude of characters that make each species a unique entity. Field studies are critical to this task. This accomplished, fewer plants with rain-damaged cups in their flowers would be named as "new" species.

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CRINUM NOTES — 1987

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NEW HYBRIDS

THE past few years have been noteworthy in the flowering of several new hybrid clones of merit. Two were offspring of 'Carnival,' and both were seed fertile. The first of these, dubbed 'Midway', was the product of 'Cecil Houdyshel' by 'Carnival'; in a sense the merging of two very old crosses, (*C.* × *herbertii*) and (*C.* × *powellii*), thereby combining the various genes of *C. scabrum*, *C. moorei*, and three forms of *C. bulbispermum*. 'Midway' is quite attractive, with flowers much more darkly colored than 'Cecil Houdyshel', of better form and with an unusually glossy sheen. Flowers are light red inside and dark red on the exterior, of average size, have a chalice form, and appear to be made of wax. Foliage is glaucous, showing the intensity of the *C. bulbispermum* ancestry. 'Midway' is a good performer in the garden, regularly producing five scapes annually from the mother bulb, plus a few offsets. Even so, perhaps its most useful feature is its ability to set seed freely, something uncommon with the majority of the older *Crinum* hybrids. 'Midway' itself is a third generation hybrid, with complex fourth generation offspring now growing huskily for the writer.

Even more exciting than 'Midway' is another new hybrid named 'Circus.' It is the result of 'Carnival' being pollinated by 'White Queen' (Burbank/Henderson), thereby merging genes of *C. scabrum*, *C. moorei*, *C. macowanii* and three distinct forms of *C. bulbispermum*. The huge flowers are goblet-shaped and open widely, with many flowers opening at the same time, giving the fully radial umbel an impressive and formal appearance. The exterior of each flower is a dark red; the interior is a light red with a white throat. There are often white or pink stripes in a few of the flowers, as with 'Carnival'. The segments are astonishingly wide, up to 2 1/8 inches and the broadest I have yet recorded for any *Crinum*. The tepals recurve strongly at the tips, giving the flowers much character and gracefulness that belie their size. In this respect, its form reminds one of 'White Queen', and is a character inherited from *C. macowanii*. The lovely 'White Queen' was a Burbank hybrid introduced by Henderson in the late twenties or early thirties. 'Circus' is slow to produce offsets, although having now flowered for three years. Since *C. macowanii* rarely makes offsets, this trait is sometimes passed on to some of its hybrids, and is undesirable from a nurseryman's standpoint. The foliage of 'Circus' is massive and fountain-like, but the flowers are wonderfully self-fertile and are a breeders wish-dream come true. We already have a number of seedlings from 'Circus' pollinated by a variety of pollens from *Crinum* hybrids.

EXPEDITING HYBRIDS

It appears that *Crinum* breeding is in a new era of more complex pedigrees, improved fertility, larger flowers, and perhaps stronger colors. Breeders need no longer content themselves with merely doing F-1 exercises between species. The time has finally arrived when we can enjoy *Crinum* hybrids where not only are both parents hybrids but

so are the grandparents. Pedigrees that once could only boast of two or three ancestral species, can now list four, five or even six different species in a complex parentage. The genes are churned up considerably, thus giving vent to many future surprises. Until recently *Crinum* breeders had to collect a large number of species in order to try for new combinations. This is now passé. One can now save many years of experimentation and valuable garden space by acquiring a few good, fertile hybrids for seed production, plus a few good selections in the better hybrids to be used for pollen donors. I once wondered if I would see this situation in my lifetime, but that shared dream has made this breakthrough possible. Many of the new hybrids apparently are tetraploids, and interbreeding them may create a race of fertile super-polyplids. They are more robust than their diploid companions, flowering from seed in a shorter time-frame, thereby allowing for more generations per decade.

CRINUM ERUBESCENS

The 1984 *Herbertia* contains an informative article by Luther Bundrant on various similar hybrids of *C. × submersum* and *C. × digweedii*. Recent hybrid experiments by both Bundrant and the writer have confirmed Herbert's supposition that *C. × submersum* is of hybrid origin. Indeed, we have the word of Herbert himself concerning hybrids between *C. scabrum* and a large form of *C. erubescens* that he himself had done at Spoforth. Meanwhile, in attempting to duplicate crosses of *×. digweedii* or *×. submersum*, using *C. scabrum* and *C. erubescens* (large form), I was ultimately able to repeat Herbert's *C. × submersum* in one of the "finger mules" that he spoke of. A robustum form of *C. erubescens* var. *octiflorum* was described by Herbert among a total of eight different forms of that species. Since the middle of this century this plant has been misidentified as a "robustum" form of *C. americanum*, first by the late Cecil Houdyshel, and later named *C. americanum* var. *robustum* Hannibal. This is not the same plant as *C. americanum* var. *robustum* described by Traub in 1958, which was based on a Texas selection of *C. americanum*. The Hannibal "robustum" is a form of *C. erubescens*. Herbert referred to two large forms of *C. erubescens* var. *majus*, and *C. e.* var. *octiflorum*. Hannibal was aware of this, but appears to have misapplied the variety to *C. americanum* instead of *C. erubescens* where I believe it rightfully belongs. The two species are somewhat similar. In my opinion it was not until my 1986 trip to Brazil that the correct identity of *C. erubescens* was resolved. *C. erubescens* is found in Central America and South America, along the Atlantic coast, all the way down Brazil to near the Uruguayan border. The writer collected from two widely separated colonies, and found the robust form *C. e.* var. *octiflorum* used as a landscape plant along walkways in downtown Rio de Janeiro. The deep green foliage, rust red scapes and large white flowers were unmistakable. All forms of *C. erubescens* I encountered grew well in dry situations that would spell certain failure for the more aquatic *C. americanum* forms. Herbert spoke of *C. e.* var. *octiflorum* as regularly producing eight flowers per scape, whereas normal forms of both *C. americanum* and *C. erubescens* average out four buds per scape, with the largest forms having six. In certain robust Texas forms of *C. americanum*, I have seen two individuals with eight bud counts. So did Traub, and he wrote of it in *Plant Life* 14:51-52 (1958).

The important thing (from a breeder's view) is that *C. erubescens*, in the largest forms, yields hybrids that are apparently superior in size to the common forms of *C.*

americanum. Such hybrids will have larger flowers, better pigmentation in leaf and scape and should better withstand dryer garden conditions. Apparently the relationship of **C. americanum** to **C. erubescens**, and to their closest relations, **C. commelynii**, **strictum**, and **loddigesianum** is so blurred that a modern revision is in order. Hannibal proposed defining them by the ratio of the tepal-tube lengths to the segment lengths. Such ratios, though well intended, do not work for Texas forms of **C. americanum**, which are much too variable to be "pigeon-holed" so neatly. The "splitters" have had a field-day with this group until now, but it is time for the "lumpers" to try to make some sense of it all. We might find a few beloved species demoted to subspecies level in the adjustments, but there is nothing wrong with that, as long as the unique characters are recognized.

'ROYAL WHITE'

C. × digweedii is a very old cross between **C. scabrum** and **C. americanum**. Henderson (circa 1937), having acquired it from the Burbank collection, selected the name 'Royal White' in order to market it in his catalog. This was a common practice applied to clones of unknown origin. Herb Kelly, in *Plant Life* 39:78-80 (1983), wrote of 'Royal White' and Henderson, giving a detailed description of the clone, complete with illustration. Unfortunately, more recent findings by Pat Malcolm and Martha Williams in Georgia and Florida have uncovered more clones of **C. × digweedii**, and the distinction between them, though clonal, are much too fine to try to maintain them as anything more than a series of clones of **C. × digweedii** and/or **C. × submersum**, in most cases.

'STARS 'N STRIPES'

In 1974, the writer made a couple of crosses involving **C. scabrum** with **C. erubescens**. Twenty seeds were secured, of which the mortality rate was inordinately high. Ultimately three survived to maturity. One clone was more robust, and was the first to flower. The flowers were colored exactly like **C. scabrum**. Because of poor health, I consigned this bulb and its offsets to the late Marcia Wilson to grow on, along with a number of other bulbs from my garden, as a business arrangement. Marcia was able to flower and propagate it, and was so impressed with it that she asked me to name it so that she could introduce it. The flowers are strikingly large and well-formed, with such startling crimson stripes against a white background, that I dubbed it 'Stars 'n Stripes'. From 1979, that clump had increased from a half dozen bulbs to a clump in excess of 120 bulbs in late 1983, at the time of Marcia's death. In February 1984, I was invited to Brownsville to retrieve my hybrids. There were twelve large clumps at this time, each with more than a dozen bulbs. I kept one clump, and later received another clump with over twenty large offsets. It is easy to see that 'Stars 'n Stripes' is both very beautiful and prolific. A second clone to flower came into bloom in late November, and the cool weather deepened the pigmentation to a crimson exterior and rosy, striped interior. Since then it has steadfastly refused to flower again, so that it could not be assessed under a more normal, warm summer situation. The third clone had flowers greatly resembling 'Royal White' in all respects, save that the flowers were slightly smaller, yet had wider, more bluntly tipped segments. Color and fragrance were identical to 'Royal White'. This clone too has refused to flower since. Marcia Wilson was most enthusiastic over 'Stars 'n Stripes', and had she lived, planned to feature it as a new introduction for 1985. Though very fond of my 'William Herbert', which she personally registered in *Plant Life* 38:110 (1980), she was firmly convinced that 'Stars 'n Stripes' was my best effort in the field of striped

hybrid **Crinum**. Recently, a kindly **Crinum** enthusiast wrote to say that, "My impression was that I have never seen such a beautiful **Crinum**." Since only three of twenty possible clones survived, one can only speculate as to how the others might have differed. Certainly they can differ not only in vigor and pigmentation, but even in the fragrances, which vary from subtle to almost overpoweringly sweet.

'PARFAIT'

Undoubtedly equal to the best of my newest hybrids, my 'Parfait' is uniquely different from all other **Crinum** sect. **Codonocrinum** yet experienced. Here again, **C. scabrum** was the seed parent, with 'Krelagei' (a form of **C. × powellii**) serving as pollen parent. Unfortunately, 'Krelagei' seems to have disappeared from the trade, and what a pity, as it was perhaps the finest of all **C. × powellii** hybrids, with nearly perfect form, and a good clean, delicate-pink color (**Herbertia** 5:134 [1938] for photograph). The crossing of **C. scabrum** with 'Krelagei' was fortuitous, in giving us a totally new concept in modern **Crinum** hybrids. The color pattern is similar to those of **C. × augustum** and **C. × amabile**; that is, the exteriors are dark purplish-red, and the interiors are a soft pink with darker wine-pink stripes beginning at the throat and vanishing about 2/3 of the way toward the tips. The combination is both exciting and pleasingly harmonious. The flowers are of good form and very large when well-grown, with very good substance in the garden. Foliage of 'Parfait' is **C. scabrum**-like, low and spreading but bluish-dark green. 'Parfait' has potent pollen; in 1985 one seed was set, and in 1986 two seeds set. Thus, it may possibly be a seed-fertile clone when fully tested. It increases acceptably well, and large bulbs now average three scapes per season.

'YELLOW TRIUMPH'

In recent years, I have exchanged ideas with some of the modern **Crinum** breeders, such as Luther Bundrant, Pat Malcolm and Herb Kelly. Each of them has made significant new contributions to horticulture with their hybrids and I feel sure we will be hearing from them in the future. Herb Kelly was the first to flower a yellow-flowered hybrid **Crinum** with his 'Yellow Triumph', a cross from **C. bulbispermum** var. **alba** and the yellow flowered form of **C. flaccidum**. Both Luther Bundrant and I have made this cross but have only unflowered seedlings. Kelly obviously won the sweepstakes in the race for a yellow hybrid.

BUNDRANT HYBRIDS

Meanwhile, Bundrant is enjoying the fruits of his labors with the flowering of several new clones. His 'Birthday Party' is especially attractive, looking much like the **C. × worsleyii** hybrids, with the color a richer, darker red. 'Birthday Party' is a hybrid of **C. scabrum** × 'Bradley Giant'. The latter was sent to us by William Morris of Australia. Another uniquely lovely hybrid experiment is Bundrant's 'Jubilee' which is somewhat reminiscent of Henry Nehrling's 'Mrs. Jones Hendry' in color and form. 'Jubilee' is the result of **C. loddigesianum** pollinated by **C. × digweedii** 'Royal White' resulting in lovely, patent flowers, purplish on the exterior and pinkish-white within. Another interesting Bundrant hybrid is 'Pieturesque', a hybrid between two Mexican species, **C. cruentum** and **C. loddigesianum**. Though obviously intermediate in appearance, it seems to have even longer tepal tubes, and curiously ruffled segments that reflex gracefully.

KELLY'S 'FRESNO'

With Herb Kelly's finding of an unidentified *Crinum* around Fresno, California, there was much stirring and flapping in the old *Crinum* "henhouse". One *Crinum* enthusiast thought it to be Baker's *C. abyssinicum* suggesting that it was the ancestor of a line of hybrids from the early part of this century, including 'Ellen Bosanquet'. However, 'Fresno' (as it was tentatively dubbed by Kelly) did not stand up well under scrutiny. The current consensus is that 'Fresno' is merely a well-marked variation of *C. yemense*. It does not appear to match Baker's description of *C. abyssinicum*, in size, leaf, or flower. Moreover, recent breeding experiments by Kelly do not support the theory of its ever having been valuable for breeding. The flowers of 'Fresno' are long and tubular, and often do not open well. The long, narrow trumpets look like those of a scrawny lily and quickly droop early in the morning before the sun hits them. Thus far, hybrids of 'Fresno' have been disappointing and not particularly distinguished. Kelly first bloomed a 'Fresno' hybrid pollinated by *C. × powellii* var. *alba*, and though modestly pretty (according to Kelly) it was insignificant. Later clones to flower, from other pollens, have fared no better. Eventually, the chances may tilt, and we may find a few hybrids of 'Fresno' distinguished enough to merit a place in the average garden.

CRINUM ZEYLANICUM

C. zeylanicum, on the other hand, continues to gain in stature as a classic parent in Florida hybrids created by Messrs. Nehrling, Mead and Bosanquet as more and more distinctive clones surface from the prowlings of Marty Williams. Pat Malcolm has found a few interesting *C. zeylanicum* clones too. Between Malcolm, Williams, and myself, there must easily be a dozen striped hybrid clones of *C. zeylanicum* hybrids, all different. Most of these are a series of hybrid experiments between *C. zeylanicum* and *C. americanum* and are striped *Crinum* sect. *Platyaster* taxa in the classic *C. zeylanicum* pattern, offsetting easily, making smallish plants, are fragrant, self-sterile and on the tender side. A few may be hybrids of *C. erubescens*. If so, they would be a bit larger in all parts, taller and have rust-red scapes. 'Southern Belle', 'Maximilian', 'Maurine Spinks' and others are of this general group.

'J. C. Harvey' is one of the earliest *C. zeylanicum* hybrids of solid pink coloring and has proven to be a useful pollen parent plant since its introduction at the beginning of this century. The present consensus is that 'Ellen Bosanquet' was the product of *C. scabrum* × 'J. C. Harvey', with the mingled genes of *C. scabrum*, *C. moorei* and *C. zeylanicum* contributing to its unique characteristics in habit, leaf form, and rich wine-red coloring.

C. zeylanicum was introduced into Florida in the last century and became the most common species in cultivation there. For a long time, its identification was partly obscured under the epithet *C. kirkii* Baker. Some older articles refer to *C. kirkii* and it was not until much later that we realized that *C. zeylanicum* and *C. kirkii* were both one and the same as grown in Florida. (See Wyndham Hayward's article about *C. zeylanicum* in *Plant Life* 8:130-132 (1952). Nordal, in the *Nordic Journal of Botany* in 1980, deftly took care of the confusion by making *C. kirkii* Baker a synonym of *C. zeylanicum*. By the same token, she made *C. ornatum* another synonym for *C. zeylanicum*.

CRINUM CRUENTUM

In the summer of 1985, Herb Kelly accompanied me on a field trip to Mexico. He was naturally interested in collecting *Crinum* from the tropics, and returned with quite a haul. Of special interest to both of us was the finding of *C. cruentum* at a new location in the state of Morelos. Being a streamside plant, it occasionally gets into the irrigation ditches, becoming an invasive weed pest. Mexicans hack it with machetes, but it keeps fighting back with its plentiful stolons. In spite of this, the species is endangered and quite rare. Unlike its other Mexican *Crinum* relatives, *C. loddigesianum* and *C. strictum* (which are only found at sea level), *C. cruentum* is a highlander and grows at the 5,000–6,000 foot elevation.

At Tamazunchale, San Luis Potosi, Herb and I stopped to take measurements of *Crinum* × *amabile* standing seven feet tall with foliage 8" wide. The huge flowers spanned 13" which surely makes it the "size queen" of all *Crinum*. We dug a bulb that weighed twelve pounds. Both *C.* × *augustum* and its sister *C.* × *amabile* are ancient hybrids of *C. zeylanicum* and allied forms of *C. asiaticum procerum*, from around the Indian Ocean, and were doubtlessly distributed by early mariners long before Columbus. There is a European bias that nothing happened prior to Columbus, but this is pure arrogance combined with ignorance. The Indian Ocean was quite an active place for traders in pre-Columbian times. Last October, the writer found the "other" form of the *C. augustum/amabile* duo growing about Southern Brazil, as well as in the city of Rio de Janeiro. Just as stated in older literature, both clones have flowers that are in all respects identical in size, form, fragrance and coloring. They differ in that the Brazilian plant, *C.* × *augustum*, has slightly larger bulbs, and foliage that is somewhat shorter, lower in the center, and more spreading. It is a decidedly squattier plant than the clone common in Mexico. Only one plant of the taller form of tropical Mexico was seen in cultivation in Brazil. Thus, it is apparent that these two clones did not receive equal distribution by the early traders.

Herb Kelly and I found 'Maximilian' planted about the city square of Ciudad Victoria, Tamaulipas. Until then, I had known it only from general cultivation about Sabinas Hidalgo, Nuevo Leon, in northern Mexico. It is a hybrid of *C. zeylanicum* and one of the several hypocrateriform species and is very distinguished in its own right. Although one of the several striped kinds, here the central red stripes are very broad against the rather narrow segments, so that the effect is that of a red flower with white margins.

While *Crinum* hunting with Hannibal in 1967, just north of Manzanillo, Colima, we encountered a tall, attractive *Crinum* with flowers drooping in the early sun in front of a home near the roadside. Hannibal was uncertain of its identity, but I told him that I thought it looked like 'Empress of India' which I had obtained from Wyndham Hayward in the late fifties, and which had eventually been lost one very cold winter after having flowered and being photographed by me. For the sake of convenience, I tentatively dubbed the plant 'Empress of Mexico', in order to distribute it with some sort of identification, keeping in mind its resemblance to 'Empress of India'. Eventually, I learned that it was indeed 'Empress of India', thanks to help from Marty Williams, plus the finding of my old photo of Hayward's bulb taken in the fifties. 'Empress of India' has long been both liked and disliked because of its nocturnal flowering habits. Only in very cool weather do the flowers last well into the day. This old clone was named for Queen

Victoria, who indeed had the title "Empress of India". Though we are not certain of its exact pedigree, *C. zeylanicum* was likely one of its parents, and one of the riverine Indian sect. *Platyaster* species serving as the other. Queen Victoria's namesake is alive and well in coastal Mexico and is still thriving in Florida as well, though no longer correctly identified. It was never reputed to take winter cold very well, but I am of the opinion that it is not the colder soil temperatures themselves that do the dirty work, as it is the associated soil pathogens that cause basal rot. This may be due to the fact that the Indian riverine parent is aquatic in the summer and is in an enforced dormancy state when the river beds dry off. Thus, perhaps 'Empress of India' needs not so much a warm winter, as a DRY winter. In any event, it is a beloved and historical hybrid *Crinum* which the writer would not care to be without.

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